SEA AND INLAND

FISHERIES

REPORT FOR 1963

AN ROINN TAILTE, FO-ROINN IASCAIGH,
(Department of Lands, Fisheries Division)

DUBLIN:
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REPORT

OF THE

MINISTER FOR LANDS

ON THE

SEA AND INLAND FISHERIES

FOR THE YEAR

1963

PART I

SEA FISHERIES

The total value of landings of sea-fish in 1963 was £1,413,690 as against £1,498,995 in 1962. Excluding shellfish, the total quantity was 399,280 cwt. valued at £1,059,827 as compared with 441,149 cwt. valued at £1,169,201 in 1962 ; the value of the demersal catch at £829,367 and that of the pelagic fish at £230,460 showed decreases of £37,180 and £72,194 respectively. The shellfish catch rose, however, by £24,069 to £353,863. A more detailed account of the fishing in each of these sectors is provided in subsequent paragraphs of this report.

The quantity and value of sea-fish landed (excluding shell-fish) each year since 1954 are given hereunder:—

TABLE I.

Year		cwt.	£
1963	...	399,280	1,059,827
1962	...	441,149	1,169,201
1961	...	516,207	1,079,556
1960	...	688,421	1,271,980
1959	...	592,319	1,205,971
1958	...	547,377	1,025,505
1957	...	532,475	907,119
1956	...	377,367	787,160
1955	...	303,519	686,195
1954	...	254,714	635,802

Particulars of the varieties landed are contained in Appendix No. 1, and the average value per cwt. for each variety from 1956 onwards is shown in Appendix No. 2.

As in previous years, imports of white fish, mainly plaice, were permitted during the year when supplies from home landings fell short of requirements. Occasional imports of herrings were also allowed in similar circumstances.

In order of value of fish landed, the principal ports in 1963 were:— Castletownbere, Killybegs, Howth, Dingle, Dunmore East and Gal-

way. This order differed from that of the previous year in that Killybegs advanced to second position in place of Howth and Dingle to fourth position in place of Dunmore East.

DEMERSAL FISHERY.—Demersal fish landings fell by nearly 9% to 210,318 cwt. from 230,110 cwt. in 1962. This drop was more than accounted for by a reduction, particularly in the last quarter of the year, of landings of whiting which at 89,039 cwt. showed a decline of 24,806 cwt. on the figure for 1962. Despite this decrease, whiting continued to be taken in by far the greatest quantity, the catch being over 40% of the total demersal landings. Ray, plaice, cod, haddock and pollack followed whiting in order of landed weight. Brill, turbot, plaice, megrims, ray/skate, cod, haddock and pollack all showed some increase on the previous year's figures.

The quantitative decrease in landings was partly offset by a rise in the level of first-hand prices with the result that the total landed value at £829,367 was only 4.3% below that for the preceding year. Varieties which did not, however, benefit from higher prices were plaice, megrims, haddock, cod and hake.

The following table shows quantity, total value and average value per cwt. of demersal fish in the past ten years.

TABLE 2.

Year	Cwt.	£	Average value per cwt.
			s. d.
1963 ...	210,318	829,367	78 10
1962 ...	230,110	866,547	75 4
1961 ...	212,703	820,911	77 2
1960 ...	233,785	818,828	70 1
1959 ...	258,178	800,698	62 0
1958 ...	258,978	717,306	55 5
1957 ...	259,722	693,330	53 5
1956 ...	225,488	660,674	58 7
1955 ...	193,916	593,190	61 2
1954 ...	169,926	540,690	63 7

PELAGIC FISHERY.—*Herrings:*—In 1963, the total quantity of herrings landed at Irish ports amounted to almost 166,000 cwt. as compared with 188,000 cwt. in 1962. During January, when the 1962/63 herring fisheries at Dunmore East and off the Donegal coast terminated, landings came to 75,000 cwt. as against 46,000 cwt. in January, 1962. This increase was, however, more than countered by a disappointing drop in landings during the period from October to December. The average unit value, which in early 1963 was almost exactly the same as in the corresponding period of 1962, also declined in the latter part of the year with the result that the average unit value for the entire year fell to 23/4d. per cwt. from 27/9d. in 1962. The Achill herring fishery, which in 1962 yielded some 12,000 cwt., failed almost completely in 1963, despite intensive and prolonged efforts by local boats and by visiting boats, mainly from Burtonport, to locate the shoals.

The 1962/63 herring season at Dunmore East concluded on 28 January with relatively heavy landings having been made during that month. The 1963/64 season opened on 17 October with small landings from Waterford Harbour by a few boats from Passage East. The quantity landed in October and November at 19,000 cwt. was approx. 50% more than that for the like period of 1962, but during December rough weather had a very severe effect on landings which amounted to less than 13,000 cwt. as compared with almost 42,000 cwt. in December, 1962. Prices were somewhat lower than in 1962, a contributory factor being a lessening of demand from continental buyers. Some 25 boats, including those locally based and vessels from Kilmore Quay and ports on the east coast, participated in the fishery which was concentrated mainly in the area between the Hook and Tramore and in the offshore waters. Trawling accounted for the bulk of the catch.

Herring fishing off the Donegal coast in January, 1963, when the 1962/63 season came to a close, was relatively good, with some heavy landings at Killybegs in particular. In September landings of about 2,800 cwt. of prime herrings were made at Killybegs by boats engaged off the Mayo coast but the 1963/64 Donegal herring fishery proper did not commence until 29 October. Landings in November were slightly less than half those for November, 1962, due to interruption of fishing by bad weather but the December landings improved almost to the level of the catch in December, 1962. Prices were generally lower than in the previous year, due probably to apprehensions that the requirements of the export market for processed herrings might already have been largely contracted for by other European suppliers. The landings were, however, disposed of fairly readily for both the freshing and processing trades and only on one occasion, when landings reached glut proportions, was a part of the catch diverted to fish meal manufacture.

Eighteen boats, using mid-water trawls, engaged in the Donegal fishery in the 1963/64 season and landed their catches at Killybegs. Isolated ring-net landings were made by several boats during the season. The boats varied their fishing activities between the Burtonport/Glenhead area and Donegal Bay. Catches on the Burtonport grounds proved disappointing due to the fact that the herring shoals, which were normally located north of Aranmore Island, close to Burtonport, appeared to be much further south. Landings by half-deckers in the Inver/St. John's Point area were insignificant by comparison with the good landings of the previous year.

During 1963, herrings valued at £153,000 were exported in salted or marinated form, mainly to the Netherlands, Federal Republic of Germany, France, Great Britain and the U.S.A. In addition, exports of fresh chilled or frozen herrings to the value of over £120,000 were effected, principally to Great Britain, the Netherlands and Czechoslovakia.

The following table shows the quantity, total value and unit value of herrings landed in the past ten years.

TABLE 3.

Year	Cwt.	£	Average value per cwt.
			s. d.
1963 ..	165,696	196,068	23 8
1962 ...	187,534	260,463	27 9
1961 ...	250,078	209,710	16 9
1960 ...	417,414	394,945	18 11
1959 ...	308,064	364,130	23 8
1958 ...	252,759	268,579	21 3
1957 ...	233,365	173,027	14 10
1956 ...	137,849	101,608	14 9
1955 ...	96,560	73,782	15 3
1954 ...	68,322	72,848	21 4

Pilchards :—The failure of the pilchard shoals to appear off the Donegal coast in 1963 deprived the fishermen of a small but useful additional source of income in supplying the fish meal factory at Killybegs.

Sprats :—Compared with 1962, when the catch was insignificant, sprat fishing revived fairly satisfactorily in 1963, landings of some 8,000 cwt. valued at £3,500, being recorded. The main landings were in July at Killybegs and the bulk of the catch was utilised for fish meal production. In the last quarter of the year, approximately 1,300 cwt. were taken in Dingle Bay and, with a ready outlet provided by the commercial trout farm at Waterville, the establishment of a regular sprat fishery by the Dingle fleet would appear to be a distinct possibility.

Mackerel :—The total catch of mackerel in 1963 was 15,000 cwt. with a value of £34,000, as compared with 16,500 cwt, valued at £39,000, in the previous year. The main centres of activity were Castletownbere, Schull, Dingle and Kinsale. The catch was disposed of on the home market with the exception of some £800 worth exported fresh to Great Britain.

Statistics of mackerel landings over the past ten years are given in the following table.

TABLE 4.

Year	Cwt.	£	Average value per cwt.
			s. d.
1963 ...	14,970	33,753	45 1
1962 ...	16,475	39,297	47 5
1961 ...	24,007	38,238	31 10
1960 ...	37,125	58,144	31 4
1959 ...	25,645	40,978	31 11
1958 ...	35,490	39,570	22 4
1957 ...	22,913	36,209	31 7
1956 ...	13,850	24,815	35 10
1955 ...	11,563	18,913	32 9
1954 ...	14,766	21,967	29 9

SHELLFISH.—The recovery during 1962 in the value of shellfish landings was well maintained in 1963 when the value of the total catch amounted to £353,863, representing an increase of 7% on the figure for the previous year. This increase was due mainly to a rapid expansion of fishing for Dublin Bay prawns which in 1963 rated as the second most valuable branch of the Irish shellfish industry next to lobstering. Landings of Dublin Bay prawns rose to 29,000 cwt. from 17,000 cwt. in 1962, the east coast fishery contributing 8,000 cwt. of this increase. On the south coast, where new grounds came in for successful exploitation, the landings at 8,500 cwt. were more than double those for 1962. The increased supplies met with a ready demand, first-hand sales amounting to £101,000 or 28% of the total value of the shellfish catch. Lobsters, which have usually been predominantly the most valuable species, did not figure quite so prominently in the 1963 landings but nevertheless accounted for 30% of the overall landed value. The take of crawfish was slightly lower than that for the preceding few seasons, possibly because of low sea temperatures. Crabs again figured mainly as a by-catch but a demand from processing interests improved the outlook for organised commercial fishing.

Of the molluscan shellfish the escallop was the only variety which suffered any serious effects from the very severe winter of 1962-63. While the south coast beds were but slightly affected, mortality on the west coast at Kilkieran was particularly severe with the result that these grounds were not commercially fished after February, 1963, to permit them to recover. This was reflected in a drop in the value of landings to £9,000 from nearly £13,000 in 1962. As usual, periwinkles made a significant contribution towards the total value of the shellfish catch—£54,000 or 15%. A fall of over 400,000 in the number of oysters taken because of poor fishing weather was more than compensated for by the higher prices which obtained in 1963 and left the value of the catch at about the same figure, £22,000, as in the previous year. The results of mussel fishing improved with landings at 15,000 cwt. showing an increase of 8,000 cwt. on the figure for 1962. This was chiefly attributable to the beneficial effects of the transplantation scheme carried out at Cromane in 1961 and subsequent schemes are expected to give progressively better returns. The fishery at Mornington, where the quality of the mussels had unexpectedly fallen off in the preceding couple of seasons, also showed initial signs of recovery, landings of 1,500 cwt. being made compared with a bare 200 cwt. in 1962. An enterprising move was made on parts of west Cork and Kerry coastlines to exploit palourdes (grooved carpet shells) which had not previously been harvested here. This variety is popular in France where the supplies collected in 1963 were successfully marketed and repeat orders obtained for larger quantities in 1964. A small scale effort was also made to develop catches of sea urchins at places where they can be economically picked. There is a buoyant French

demand for this variety and continuing explorations seem well worth while.

Table 5 gives the value of shellfish landings in the past ten years.

TABLE 5.

Year		£
1963	...	353,863
1962	...	329,794
1961	...	277,686
1960	...	339,625
1959	...	402,716
1958	...	291,255
1957	...	239,968
1956	...	233,634
1955	...	196,103
1954	...	154,525

EXPORTS.—At £1,719,042 in 1963, fish exports—including both sea fish products (£790,592) and freshwater fish products (£928,450) (see Part II of this Report)—established a new record, being £79,898 higher than in the previous peak year of 1960.

PERSONNEL AND VESSELS.—The total number of men engaged full-time in sea fishing rose from 1,626 in 1962 to 1,666 in 1963. This increase is largely attributable to the influx to the industry of young personnel recruited under the Department's scheme for the training of boys as fishermen. There was a reduction in the number of part-time fishermen with the result the total number of men engaged fell slightly from 5,697 in 1962 to 5,588 in 1963.

The number of larger motor vessels of 25 gross tons and over engaged in fishing in 1963 was 171 as compared with 173 in 1962. While the withdrawals from the fleet in this category in 1963 were largely in the 25-49 gross tons range, the additions were mainly in the 50-125 gross tons range, the number of vessels in the latter range having increased from 15 in 1962 to 22 in 1963.

TRAINING OF FISHERMEN.—The schemes introduced some years ago for training fishermen as skippers and boys as fishermen were continued on the same lines during 1963.

Fishermen of at least twenty years of age and having a minimum of three years sea-fishing experience are eligible for allowances while in training as skippers. The training lasts for a period not exceeding twenty-eight weeks—sixteen weeks being devoted to the theoretical course at the Town of Galway Vocational School and up to twelve weeks to a practical course on selected fishing boats. The duration of the practical course depends on the fishing experience of each individual trainee. Thirteen fishermen were selected for training in 1963 and twelve were successful in their examination for Certificates of Competency, making in all a total of forty who have so benefited under the scheme since its inception in 1958.

Under the scheme for training boys as fishermen, applicants must be at least sixteen years of age and previous sea-fishing experience is not required. Boys are assigned to selected fishing boats and allowances are payable to them for a period which may not exceed two years unless they are training as enginemen. At the beginning of 1963 thirty-seven boys were being trained and fifty-nine others commenced during the year. Of that total of ninety-six, thirteen became full crew members, giving a total of thirty-seven who had so qualified since the commencement of the scheme in 1959. Eighteen boys discontinued and the remaining sixty-five were satisfactorily pursuing their training at the end of 1963.

It was decided that the experience gained by boys at sea should be supplemented by residential courses ashore so that they would derive the maximum benefit from their training. With the co-operation of the Department of Defence, arrangements were made for holding residential courses at Haulbowline Naval Base, Cork Harbour, with instruction in nautical subjects by Naval Service personnel. The County Cork Vocational Education Committee co-operated in arranging for tuition in general educational subjects at Cobh Vocational School.

AN BORD IASCAIGH MHARA.—In 1962/63 a grant of £160,000 in aid of administration and development was paid to the Board from the Fisheries Vote. The Board also received repayable advances amounting to £132,500 from the Central Fund for financing the purchase of boats and gear and lent £155,925 for that purpose.

During the year ended 31 March, 1963, the Board issued on hire purchase 18 new boats (two of 56′, two of 38′, five of 32′ and nine of 26′) valued at £72,269, provided £33,206 to finance the purchase of nine second-hand boats ranging from 50′ to 72′, resumed possession of eight boats from unsatisfactory hire purchasers. The number of motor fishing boats on hire purchase at 31 March, 1963, was 141, valued at £1,007,053 at time of issue.

Fresh sea fish (excluding shellfish and imported fish) handled by the Board during the year totalled 117,557 cwt. valued at £450,504 as compared with 125,039 cwt. valued at £490,355 in 1961/62. Losses incurred on fresh fish trading during 1962/63 amounted to £15,970, as compared with £6,856 in the previous year and arrangements were made for the Board's withdrawal from this activity.

The Board's fish processing factories at Killybegs and Galway continued to operate on inadequate supplies of raw material and, as in 1961/62, no processing was undertaken at Schull. The losses incurred on the factories in 1962/63 amounted to £26,075 as compared with £13,751 in 1961/62.

Ice was again supplied to fishermen at Killybegs, Cleggan, Galway, Dingle, Castletownbere, Schull, Ballycotton and Dunmore East. Sales of ice, although continuing to increase, were still small and

State grant of £6,000, to enable the price to the fishermen to be kept at a reasonable level, was continued.

Production in the Board's boatyards at Meevagh, Killybegs, Dingle and Baltimore was valued at £104,723 in 1962-63 compared with £101,374 in the previous year; the loss during 1962-63 (£2,107) was slightly more than offset by a profit (£2,476) on boats and gear trading.

SEA FISHERIES PROTECTION.—In the course of their patrols of the exclusive fishery limits in 1963, the Naval Service vessels of the Department of Defence arrested four foreign vessels which had been observed fishing inside the limits. The skippers were prosecuted and convictions were secured; fines were imposed and fish and gear forfeited in all four cases. The assistance of the Garda Síochána was, as usual, available in these cases and in the enforcement of fishery laws generally.

MARINE WORKS.—Preparatory works for the centres chosen for development as major fishery harbours were further advanced by the Commissioners of Public Works who also negotiated for the acquisition of necessary property.

After an examination of the report on trial borings at Killybegs and a further inspection of the site by the harbour consultant, a modification was decided on and plans of the revised scheme were prepared; tenders for materials were invited for site reclamation work. The results of the trial borings at Castletownbere were examined and, following further advice from the harbour consultant, arrangements were made for the commencement of preliminary construction works. At Dunmore East the first phase of dredging was completed and filling material for pier construction was in course of delivery.

At Howth, the trial borings were completed and the results were being examined together with those derived from the hydraulic model investigations carried out at Trinity College, Dublin. The report on the Galway harbour model investigations, carried out at the Hydraulics Research Station, Wallingford, England, was examined in conjunction with results of trial borings and soil sampling.

Minor marine works were completed at Ballyhooriskey, Benwee and Burtonport (Co. Donegal), Treagawla and Crookhaven (Co. Cork), Killeany and Port-na-Curraigh (Co. Galway) and Minard (Co. Kerry). Boring surveys were carried out at Renard Point (Co. Kerry) and Kilmore Quay (Co. Wexford) as a preliminary to the formulation of suitable schemes for these centres. Works in progress at the end of the year included deepening and improving harbours at Greencastle (Co. Donegal) and Clogherhead (Co. Louth); construction of slipway and boatyard at Ballynacarte (Co. Donegal); general improvement of land facilities at Straid (Co. Galway) and Gerahies (Co. Cork); and provision of increased berthage at Enniscrone (Co. Sligo).

EXPLORATORY VESSEL.—*Cú Feasa.*—Sixteen voyages were made during the year by the Department's ship *Cú Feasa* for the purpose of fishery investigations relating to whiting, plaice and dogfish. A sounding and bottom survey of potential fishing grounds for Dublin Bay prawns was carried out off the south coast. An account of the investigations in which the vessel was engaged has been published separately in the first number of the Department's *Sea Fisheries Bulletin.*

The *Cú Feasa* also continued to be of assistance to fishermen in searching for herrings off the south-east coast and directing fishermen to the shoals. The search was extended in April and May, 1963 to an area south of Kinsale, Co. Cork, where a substantial fishery formerly existed, but it was not successful in locating shoals.

Towards the end of the year an order was placed for a second vessel which will enable the exploratory fishing and research work of the Department to be expanded. This boat, of approximately 65 feet in length, is being built by An Bord Iascaigh Mhara at Killybegs, Co. Donegal, and is to be ready for service in 1965.

SCIENTIFIC INVESTIGATIONS.—Steady progress continued in 1963 on all existing lines of investigation. The principal matters dealt with have been reported in the first number of the Department's *Sea Fisheries Bulletin.* That information is now published separately so that fishermen and other sectors of the industry, who might not otherwise fully appreciate the valuable role which fisheries research plays in the overall development programme, can be more readily advised of progress.

Notes on (a) herring investigations off (i) Dunmore East and (ii) Donegal, (b) mackerel investigations off (i) south coast of Ireland and (ii) Donegal, (c) moulting of lobsters, (d) preserving of fish by freezing and cold storage and (e) the effect of temperature on the edibility and keeping quality of sea fish appear as Appendices 25-32 to this Report.

INTERNATIONAL AND OTHER CONFERENCES.—

(1) INTERNATIONAL COUNCIL FOR THE EXPLORATION OF THE SEA.—The Inspector and Scientific Adviser and the Inspector concerned with sea fisheries were present at the annual meeting of the International Council for the Exploration of the Sea held in Madrid from 30 September to 9 October, 1963. Prior to the main meeting, they also attended a special symposium organised by the Council to discuss the measurement of abundance of fish stocks. Officers of the Department contributed papers to the Herring, Scombriform, Hydrographical and Salmon and Trout Committees. The Inspector and Scientific Adviser was elected First Vice-President and was again elected Chairman of the Salmon and Trout Committee.

(2) COMMISSION ESTABLISHED UNDER THE INTERNATIONAL FISHERIES CONVENTION OF 1946.—This Commission held its eleventh and final

meeting in London in May, 1963, which was attended by the Assistant Secretary in charge of Fisheries and the Inspector and Scientific Adviser. For waters of interest to Irish fishermen the Commission decided on an increase, from 1 June, 1964, to 80 mm. in the minimum mesh size of any trawl net made of manila or sisal. This body has been superseded by the North-East Atlantic Fisheries Commission (see next paragraph).

(3) North-East Atlantic Fisheries Commission.—This body established by the more comprehensive North-East Atlantic Fisheries Convention of 1959 has replaced the previous Commission. The first meeting of this Commission was held in London in September, 1963, for the purpose of drawing up rules of procedure, electing officers, appointing a secretary and establishing regional and other committees. One of the Irish Commissioners, the Assistant Secretary in charge of Fisheries, was elected Chairman of the Finance Committee of the Commission.

(4) Fishing Gear Congress.—Four officers of the Department attended the International Fishing Gear Congress organised by FAO and held in London in May, 1963.

(5) Organisation for Economic Co-operation and Development.—The Department continued to participate in the work of the Fisheries Committee of this organisation and was represented at meetings held in Paris in February, July and October, 1963. The Committee proceeded with a comprehensive study of the various financial supports to the fishing industries of member States and drafted recommendations aimed at achieving increased productivity as well as the development and expansion of trade in fish and fishery products.

(6) European Fisheries Conference.—The Parliamentary Secretary to the Minister for Lands headed an official delegation to the European Fisheries Conference which opened in London in December, 1963, to consider fishery limits and other problems.

ENGINEERING AND TECHNOLOGY.—A number of freezing and cold storage establishments were examined and a report on the practices that should be followed to ensure high quality in frozen fish was prepared for the information of interested parties.

An area in Castlemaine harbour was prepared by staking with wooden posts to facilitate the collection of mussel spat intended for transplantation later to selected fattening grounds in the harbour area.

Close co-operation was maintained between the engineering and biological staffs in investigations carried out by the exploratory vessel *Cú Feasa* on whiting, plaice and dog fish. The engineering staff also set out survey grids for the purpose of location of pelagic fish and for the investigation of Dublin Bay prawn fishing grounds off the south coast.

The engineers were actively associated with the scientific staff and with technical personnel of An Bord Iascaigh Mhara in developing the over-all plan and the equipment layout of the second exploratory vessel.

LEGISLATION.—The Sea Fisheries (Amendment) Act, 1963, which became law on 16 July, 1963, enables the Minister for Finance, on the recommendation of the Minister for Lands, to waive repayment by An Bord Iascaigh Mhara of sums advanced from the Central Fund under section 18 of the Sea Fisheries Act, 1952.

Particulars of Statutory Instruments relating to sea fisheries made during the year are included in Appendix No. 22.

PART II

INLAND FISHERIES

In 1963 the total catch of salmon by all methods was 2,836,640 lb., only marginally less than that for 1962 when the catch was 2,863,838 lb. The value of the 1963 catch was £703,217 compared with £620,467 in 1962. The catch of sea trout at 91,681 lb. was very slightly higher than that of 1962 when 90,380 lb. were caught, the values being £15,231 and £15,034 respectively. Details of the quantities and value of salmon and sea trout taken in the years 1961, 1962 and 1963 are given in Appendix No. 11. Catches made in the Foyle Fisheries Commission area are not included but are shown separately in the section of the report dealing with the Foyle Fisheries Commission (page 21).

During the early part of 1963 salmon fishing in those rivers having early runs of fish was greatly affected by the prolonged spell of very cold weather. Many rivers were covered with ice and snow and conditions for netting were, therefore, very poor indeed and, in some areas, angling was also adversely affected. For the rest of the year conditions for netting were generally satisfactory and angling conditions were generally better than in the previous year, particularly during the summer. The runs of spring fish into the early rivers of the country showed a marked improvement on those of previous years but, due to the adverse conditions, the catches made in the first three months of the year bore little relationship to the strength of the runs. Included in the runs of early salmon were a fairly substantial number of large spring fish which have generally been rather scarce in recent years, a fact to which reference has been made in previous reports. Small summer fish appeared to be more numerous than in previous years so that there was no marked shortage of salmon in May and early June as had been the case in 1962. From the middle of June grilse started to run in force and in some rivers, particularly in the west of Ireland, the numbers probably equalled or surpassed those of the previous year, which was regarded as having a record grilse season for most areas. For the second year in succession the grilse ran well into October and it was a noticeable feature of the runs of many rivers that fish, mainly late grilse, were entering from the sea right up to the end of the year. Due to the more favourable water conditions in 1963 the main runs of grilse were able to enter the rivers more satisfactorily than in the previous year. The very big catches made in 1963, when viewed in the light of the improved conditions for entry into fresh water, indicate that the runs of grilse into most Irish rivers in that year were not inferior to those of 1962 when probably a much higher proportion of the total stock was captured. The spawning season in 1963 in most areas was reported to be very good. As in 1962 another noticeable feature of the runs of grilse was the high average weight and the fact that genuine grilse weighing up to 14 lb. were observed.

Considerable quantities of grilse frozen during 1962 were held for sale after the close of the fishing season and a large proportion of them was not sold and exported until after the end of the year. In consequence the export figures for the first half of 1963 included these frozen fish. The quantity of fish frozen in the 1963 season was much less than in 1962. A slightly better average price was realised for salmon in 1963, due partly to the greater runs of early fish and partly to the fact that other countries whose produce competes with Irish salmon on the markets did not have such a good season as in the previous year.

Examination of the scales of considerable numbers of fish taken at the height of the season in 1963 showed that they were almost all grilse which, before departing to the sea, had spent two years feeding in the rivers. Consequently they were derived from the eggs deposited in the 1959/60 spawning season and hatched in the beginning of 1960, becoming smolts in 1962. For two successive years, therefore, there have been excellent runs of grilse ; this suggests that conditions in the sea have been particularly favourable for the survival of the young salmon. It is not generally realised that the mortality rate between the smolt run and the return of the adult fish to the river is so high that only a slight reduction in that mortality rate will result in very greatly enhanced runs of fish.

Details of the catch in each fishery district for the years 1961, 1962 and 1963 are given in Appendix No. 12. In 1963 the catch of salmon was distributed as follows:—

Draft nets	49.2%
Drift nets	24.2%
Rod and line	12.1%
Stake nets and other commercial methods ...	14.5%

The proportion of fish taken on rod and line showed a slight improvement on that of 1962 and the actual weight of the catch was much higher than that of the previous year due, in the main, to the improved conditions in 1963 for the ascent of fish into fresh water. The average weight of salmon taken on rod and line was also up to 8.2 lb. compared with 7.5 lb. for the previous year.

A total of 9,745 rod licences were issued in 1963 compared with 9,009 for 1962. The average catch per rod and line throughout the country was 4.1 fish weighing 35 lb. and valued at £10.7.4 compared with 3.8 fish weighing 28.6 lb. and valued at £8.5.0 in the previous year. The highest average weight for rod caught salmon (11.7 lb) was as usual for the Drogheda District where there are very few grilse taken by this method. In the western districts of Galway, Connemara, Ballinakill, Bangor and Ballina, where the main catches are of grilse, the average weight was low.

The sea trout catch which, as already reported, was slightly above that of the previous year and amounted to 91,681 lb. was distributed as follows:—

Rod and line	70.7%
Draft nets	23.9%
Other commercial methods	5.4%

No reliable guide as to the catch per licence can be obtained from the available statistics because there is no indication as to the numbers of licensed anglers who fish for salmon and sea trout respectively. In the Connemara District, however, which is Ireland's leading sea trout angling district, the returns showed the average catch per licence to be about 21 sea trout weighing about 22 lb.

A long established open sea drift net fishery for salmon has been carried on by small boats from landing places in counties Donegal, Sligo and Mayo. During 1963 the catch by these boats, which consists mainly of grilse, was much better than that for many years up to 1961 and was only 13% below that of the record year of 1962. Conditions were generally favourable for the capture of fish and again the season extended well beyond the normal limits, fishing being quite productive even in the month of August. The average weight of the fish landed was also high at 6.8 lb. though it was under the 6.9 lb. for the previous year.

Due to the prevailing weather it was difficult to observe satisfactorily the migration of smolts to the sea but in most areas there appear to have been good runs. Very few outbreaks of disease were reported during the year, although there was some mortality in kelts in the early part of the year when, owing to ice and snow, they were held up in small pools in many rivers.

In an endeavour to improve the grading and packing of Irish salmon, officers of the Department paid visits to some of the main marketing centres abroad and discussed these matters with the people concerned. The co-operation of the Fishmongers Company, London, and of the various market authorities and salmon merchants has been valuable for this purpose.

In 1963 the Corporation of Dublin Wholesale Fish Market handled 104,475 salmon and grilse weighing 776,381 lb., comparable figures for 1962 and 1961 being 131,215 fish weighing 934,788 lb. and 42,316 fish weighing 303,883 lb.

BOARDS OF CONSERVATORS.—Details of receipts and expenditure of Boards of Conservators in the fishery year ended 30 September, 1963, are given in Appendix No. 18.

EMPLOYMENT IN THE INDUSTRY.—Exclusive of persons employed on the marketing and transport of fish, a total of some 6,293 persons found either whole-time or part-time employment in inland fisheries during the year. The figure includes 4,242 persons

estimated as engaged in netting for salmon under common law right, 637 employed by Boards of Conservators on protection of fisheries over the open and close seasons, 750 engaged in netting in Lough Foyle area or employed in that area as ghillies or on protection work, 100 engaged in development work on behalf of the Inland Fisheries Trust and the remainder employed by proprietors of commercial salmon fisheries, by fishery owners or by angling associations.

INSTRUMENTS OF CAPTURE.—The total number of fishing licences of all kinds issued during the year was 11,343, representing an increase of 864 on the figure for 1962. The totals in recent years were—

1962	...	10,479
1961	...	9,980
1960	...	10,059
1959	...	9,165
1958	...	11,053
1957	...	10,531

The numbers of the various classes of licences issued in each fishery district during the year and the rates of licence duty are given in Appendices Nos. 19 and 20 respectively.

OFFENCES AGAINST THE FISHERY LAWS.—Prosecutions during 1963 numbered 251 as compared with 178 in 1962. The Garda Síochána continued to co-operate with Boards of Conservators in the protection of inland fisheries during the year.

SALMON EXPORTS.—In 1963 the value of salmon exports, in fresh, chilled, frozen and smoked form, (£857,398) was the highest on record; the quantity exported (23,702 cwt.) was the highest since 1935. Figures for two years are as follows:—

	1963		1962	
	cwt.	£	cwt.	£
Fresh, chilled and frozen salmon	23,477	832,458	18,834	658,480
Smoked salmon ...	225	24,940	135	14,569

Of the total quantity exported in fresh, chilled or frozen form, 19,906 cwt. went to Great Britain, 1,780 cwt. to the Six Counties and 925 cwt. to France; the bulk of the smoked salmon went to Great Britain. The average export price for the fresh, chilled or frozen exports was £35.9.2 per cwt. as compared with £34.19.3 in 1962. These figures include landings of salmon in Co. Donegal from waters in the area administered by the Foyle Fisheries Commission.

The number of salmon exporters licensed under the Agricultural and Fishery Products (Regulation of Export) Act, 1947 (Export of Salmon) Order, 1954 (S.I. No. 275 of 1954) was 97.

DEVELOPMENT OF EEL FISHING.—Thirty-five temporary eel fishing authorisations were issued during the year. Proposals for the erection of a number of new structures were also examined.

In 1963, 3,125 cwt. of eels, valued at £45,313 were exported as compared with 2,038 cwt. valued at £33,772 in 1962 and 1,869 cwt. valued at £25,678 in 1961.

FISH CULTURE.—Construction work on a fifth demonstration fish farm near Mullingar — a double unit — was brought to an advanced stage. Plans were prepared for four small-scale private units and the promoters advised as to likely cost. In addition proposed sites were inspected and information and advice given to persons interested in small scale fish farming. Technical advice was also provided by the Department's officers to the proprietor of the demonstration fish farm at Aherlow who planned further expansion of his installations (the original unit had been expanded in 1962) and to the proprietors of two private units already in operation at Holycross (Co. Tipperary) and Goatsbridge (Co. Kilkenny) who likewise planned extension. From experience gained in the operation of the demonstration ponds it was found that the production capacity of a standard unit could be increased from about 1½ to 5 tons of rainbow trout a year by a slight modification in layout at little extra cost. This modification has been incorporated in the Mullingar fish farm and in the plans of the four new units designed during the year. The total production capacity of the small scale fish farms is now about 35 tons a year. Almost all fish produced are absorbed by the home market.

The large scale commercial fish farms at Waterville (Co. Kerry) and Woodenbridge (Co. Wicklow) continued to operate successfully during the year. Satisfactory progress was made in the construction of another commercial unit on the Milltown River near Dingle and fish rearing commenced there on a limited scale. Exports of rainbow trout amounted to 1,362 cwt. valued at £25,739 and represented the bulk of the production of the commercial fish farms during the year.

Proposals for the establishment of a large scale commercial fish farm by American interests were discussed during the year. Further steps were taken towards the establishment of an association of rainbow trout producers to promote the development of the industry.

ARTIFICIAL PROPAGATION.—Details of salmon, sea trout and brown trout ova produced at the various hatcheries are given in Appendix No. 23.

The output of salmon ova in the 1963 spawning season amounted to 4,896,000 as compared with 3,616,000 produced in the previous season. 786,000 salmon ova were distributed from the Department's hatchery at Glenties and the State-assisted hatchery at Lismore, Co. Waterford. 45,000 sea trout ova from Glenties were supplied to the Inland Fisheries Trust.

The adverse effect of very severe weather was particularly noticeable in the propagation of brown trout. Nevertheless the Trust produced over 1,000,000 fry and fingerlings almost three-quarters of

which were released in Trust waters, the balance being sold to angling associations.

Rainbow trout propagation was satisfactory and 216,000, mostly fingerlings, were stocked in selected waters. In addition 97,000 salmon fry and 22,000 sea trout fry, produced from ova supplied through the Department and reared to the unfed fry stage, were stocked in waters under the Trust's control.

REGULATION OF ERNE SALMON FISHERY.—Following consideration of the outcome of the restrictions imposed on fishing for salmon by commercial methods in the three years 1960/1962 it was decided to continue the restrictions for a further three years. Accordingly, fishing other than angling did not commence until 2 August, 1963, when 3,000 fish passing upstream had been recorded on the counter maintained by the Electricity Supply Board at Cathaleen's Fall dam.

The total recorded run of fish was 5,016 of which 242 were taken by the six draft nets operating during the short period for which fishing was open. The special local licence duty for these nets was fixed at £5 each.

ENGINEERING.—*Electrical Power Stations*:—Investigations continued into the effect on salmon stocks in the River Lee of the harnessing of that river for the generation of electricity. The investigations covered (i) methods of expediting escapement of smolts from the reservoirs and (ii) the passage of smolts through turbines; the Electricity Supply Board provided a trap net at the outlet of one of the turbines to enable smolts that had passed through it to be captured and examined.

As there are indications that at times salmon ripe for spawning tail back down the fish pass at Cathaleen's Fall on the River Erne, an effort is being made to check the position by arranging for a count of the fish passing through the upstream outlet of the fish pass at Cliff, which is several miles upstream of Cathaleen's Fall and to correlate the numbers passing both dams into the spawning areas of the catchment.

At the request of the Dublin Board of Conservators, discussions were initiated with the Electricity Supply Board with the object of providing a programme of artificial freshets to stimulate and expedite fish movement in the River Liffey.

The thermal-electric power station under construction at Great Island on the joint estuary of the Rivers Suir and Barrow was the subject of continued discussion with the Electricity Supply Board to ensure that the fisheries in the river system would not be adversely affected by the cooling water arrangements of the station.

Arterial Drainage:—Work continued on the major arterial schemes for the basins of the Rivers Moy, Inny, Maine, Corrib, Broadmeadow, Deel and Killimor. To the extent practicable,

spawning areas and shelter and angling pools were preserved and provision was made to facilitate fish movement past obstructions. Where water surfaces will be lowered, recommendations were made where necessary to minimise adverse effects from the new levels. Complaints from angling associations about the effects of drainage work on fishing waters were examined and in a number of cases it was possible to get agreement as to the arrangements to be made to meet the complaints. Work was also in progress in intermediate drainage schemes carried out by public works contractors. Two new schemes of this nature were put in hand during the year and, at the instance of Fisheries Division, suitable provisions were incorporated in the contract documents to ensure as far as practicable the protection of the fishery interests.

The Office of Public Works agreed to finance an extension of the fish rearing facilities operated at Mullingar by the Inland Fisheries Trust to facilitate a five year restocking programme as part of a scheme of rehabilitation already agreed between Fisheries Division and the Office of Public Works for waters which have been developed by the Trust and are affected by drainage operations.

The question of the effects of post-drainage maintenance work on fisheries has not been resolved. In some cases, however, compromise measures to safeguard fisheries were agreed.

Where the Office of Public Works made known the intentio nto prepare drainage schemes for further rivers, arrangements were made by Fisheries Division to collect and map all relevant information about fishery interests in each catchment to enable suitable precautions to be incorporated in the schemes for the protection of the fisheries.

Counting of fish in rivers:—The tunnel electrode arrangement provided for the fish counter at the fish pass in the sluice barrage at Galway proved unsatisfactory in the flow conditions at the site and a new tunnel was resited at the head of the pass. Continuous counting proceeded during the period 14 to 31 December, 1963, when 500 salmon were recorded passing through the fish pass.

A similar electronic counting arrangement, but battery instead of mains operated, was installed at the new Ennistymon fish pass. Satisfactory full time working continued for a period of six weeks during the season when 598 fish were counted.

The smolt trap at Galway sluice barrage was in operation and 32,000 smolts were counted from 18 March to 30 June 1963. It is believed, however, that many smolts and other fish were able to pass downstream through the barrage gates in the flow conditions that existed during the period of fish movement.

A salmon counting installation incorporating a Denil type fish pass and an electronic fish counter similar to those referred to above was completed in the River Bunree, a tributary to the River Mo ynear Ballina. It came into operation o n7 December, 1963, and in the 24 days to the end o fthe year 283 fish were counted.

Salmon Culture Installations:—Work continued on the salmon hatchery and rearing station at Cong which came into partial operation during the 1963 spawning season. Delay in completion due to exceptional floods prevented full operation.

A preliminary design was prepared for the construction of new migratory fish trapping installations for the Salmon Research Trust at Furnace, Co. Mayo.

Maintenance work was carried out at Glenties salmon hatchery.

River Improvement Scheme:—The major fish-pass project at Ennistymon was completed during the year and first reports of ascent of fish were encouraging. A number of proposals for the rehabilitation of spawning stretches or the formation of pools to improve fishing rivers were examined and grants recommended where considered desirable. The results achieved have been encouraging.

General:—Fishery District Maps were prepared for the Ballina and Sligo Districts and a general map of Ireland showing all the fishery districts. In connection with the Scientific Exhibition held at Ballsbridge, Dublin, a special working model of a fish pass fitted with one of the standard electronic fish counters was constructed and exhibited together with a scale model of the new fishway at Ennistymon; they attracted considerable attention.

Proposals for the discharge of effluent from five new undertakings into fishery rivers were investigated. Two existing discharges were examined and remedial measures which were suggested were eventually carried out. Eight proposals to abstract water were examined and appropriate recommendations were made to ensure that injury to fish life would not result.

FOYLE FISHERIES COMMISSION.—A wetter season in 1963 facilitated the upstream movement of fish but nevertheless catches by commercial fishing engines exceeded those in 1962, which had been a record year. Conditions for angling were generally favourable but rod catches were rather disappointing except in the case of one or two rivers, especially the Finn and Reelan, where above average catches of sea trout were particularly good. It is of interest that the redd count in the Mourne system of rivers for the winter of 1959/60 was one of the lowest for many years although the record run of grilse in 1963 was largely derived from fry hatched in that winter. Details of catches as published in the Commission's report were as follows:—

	Salmon		Sea Trout		Total	
	Number	lb.	Number	lb.	Number	lb.
Nets ..	123,878	916,846	1,621	2,164	125,499	919,010
Rods ..	1,945	17,479	2,996	2,904	4,941	20,383
TOTAL ..	125,823	934,325	4,617	5,068	130,440	939,393

The following regulations were made by the Commission:—

(i) Foyle Area (Prevention of Pollution) Regulations, 1963;

(ii) Foyle Area (Rivers Faughan and Roe Angling) Regulations, 1963;

(iii) Foyle Area (Pension) Regulations, 1963.

Investigations were undertaken by the Commission in relation to (i) the probable escapement during the extended weekly close time imposed in 1962, (ii) the composition of the runs of adult fish in the system and (iii) the growth and movement of parr, smolts and brown trout in two selected tributaries. A total of 705,000 fry were hatched at the Commission's hatchery and distributed in various tributaries. Of ninety-eight prosecutions taken for breaches of the fishery laws, eighty-two resulted in convictions.

Full details of the Commission's activities are contained in its Annual Report.

INLAND FISHERIES TRUST, INCORPORATED.—The increased grant-in-aid from the Fisheries Vote (£75,000) enabled the Trust to intensify its angling development programme. The encouraging response by members of angling clubs and riparian owners to the appeal for more active participation in such ancillary work as predator control, improvement of spawning grounds, tree planting, bank clearance etc. permitted the Trust to concentrate its efforts on the primary work of fishery development. Despite heavy mortality in brown trout ova caused by severe weather early in 1963 and further losses of fish later in the year caused by flooding at Roscrea, over 1,000,000 fry were produced, of which some 360,000 were planted out as summerlings and fingerlings. In addition, over 200,000 rainbow trout fingerlings and yearlings were released in selected waters. Smaller quantities of salmon and sea trout ova were also hatched experimentally and planted out as fry in two waters in Cork and Kerry.

Development of coarse fish waters progressed satisfactorily. Improvement of access to fisheries was the main problem at a number of centres, while excessive weed growth was the major problem at others. The latter is being made the subject of special investigation. Stocking was carried out in selected waters, mostly tench.

Collection of information on sea angling continued with the active assistance of most local angling clubs but a great deal remains to be done in this sector.

The general study of the feeding pattern of trout in Irish waters, which has been in progress for a number of years, is being extended to include studies of the fauna of these waters with particular reference to aquatic insects. The object is to obtain data which will assist in the classification of small lakes. A fundamental study of the biology of Irish coarse fishes is also planned, beginning with bream, rudd

and tench. Studies of the flora of various types of waters and experiments in weed control using chemical and mechanical methods, which have been in progress for some time, are being continued. Full details of the Trust's activities appear in its Annual Report.

SALMON RESEARCH TRUST OF IRELAND, INCORPORATED.—During the year four further rearing tanks were constructed at Furnace. In common with other hatcheries and rearing stations the Trust had to contend with very severe weather in January and February but, despite a poor start, operations were generally satisfactory and losses light.

Good progress was made on research work and further data on survival, migration, growth rates, homing instincts and absence habits of salmon and sea trout (including hybrids) were collected and examined. Details of the work undertaken and interesting conclusions, some of them tentative, are given in the Trust's Annual Report.

In addition to work at the Trust's installations, experimental work was undertaken with the co-operation of the Fisheries Division at Ballinlough Lake, about five miles south of Newport, Co. Mayo. The lake was stocked with fry of salmon/sea trout hybrids, and the progress made by these "wild" fish will be co-related with that made by similar fish reared artificially. Reared smolts were tagged by the Trust at Invergarry, Inverness-shire as part of an international salmon smolt tagging experiment.

Under the direction of a sub-committee, the Peat Silt Research Group, the Trust continued its work on a quantitative survey of the Owenmore River and conducted experiments to ascertain the effect of peat silt on salmon ova and fry. Particulars of the work done are given in appendices I and II to the Trust's report.

LETTING OF FISHERIES.—Arrangements for the letting of fisheries owned by the Land Commission and by the Forestry Division of the Department have been handled by the Fisheries Division in recent years. Fifty-five fisheries were offered for letting in 1963. One hundred and fifty-five properties in all are involved and the amount received in rents during the year was £3,102.5.6.

INTERNATIONAL AND OTHER CONFERENCES.—(1) SALMON RESEARCH GROUP.—This group, established by the British Development Commissioners to provide a forum for the discussion of problems relating to the Atlantic salmon, held two meetings in 1963 at which the Department was represented. The first meeting held at Cambridge on 29 March, which was devoted to salmon rearing, was attended by the Inspector and Scientific Adviser, the Engineer and a representative of the Salmon Research Trust of Ireland, Inc. The meeting was addressed by Mr. K. Vik of Norlaks, Sykkylven, Norway, and Dr. B. Carlin of the Salmon Research Institute of Sweden. The second meeting was held in London on 4 December when the question of the efficiency of conversion of yolk in salmonid development was

discussed. This was attended by the Inspector and Scientific Adviser and a representative of the Salmon Research Trust of Ireland, Inc.

(2) SALMON AND TROUT ASSOCIATION.—In November, 1963, the Inspector and Scientific Adviser, the Engineer and one of the Assistant Engineers, together with representatives of the Salmon Research Trust of Ireland, Inc., and of the Inland Fisheries Trust, Inc., attended the annual conference of the Association which was held in London and devoted its attention to the subject of river management and improvement.

(3) INTERNATIONAL CONFERENCE ON WATER STUDIES.—This conference, which was held in Liege from 28 to 31 May, 1963, was attended by two officers of the Department and a representative of the Salmon Research Trust of Ireland, Inc. The matters dealt with included water quality requirements of fishes, scientific survey of rivers, methods for surveying and evaluating river pollution, waste water purification methods, problems in disposal of industrial effluents, employment of used industrial waters in agriculture and surface and ground hazards due to use of insecticides and other phytosanitary substances.

(4) EUROPEAN INLAND FISHERIES ADVISORY COMMISSION.—The Inspector and Engineer was present in the capacity of an observer at a meeting of a Working Party on Water Quality Criteria for European Freshwater Fisheries which was held in London in July.

(5) SUPERVISORY GROUP ON METHODS OF EXCLUDING FISH FROM WATER INTAKES.—Meetings of this group are held to enable representatives of various fishing organisations—mainly in Great Britain—to discuss the subject of excluding fish from water intakes. Two Assistant Engineers of the Department attended a meeting of the Group which was held in London in July.

LEGISLATION.—Particulars of Statutory Instruments relating to inland fisheries made during the year are included in Appendix No. 22.

SEOIRSE Ó COLLA,

Parliamentary Secretary
to the Minister for Lands.

29 *January*, 1965.

APPENDICES TO THE REPORT ON SEA AND INLAND FISHERIES FOR THE YEAR 1963.

Appendix No.		Page
1.	Quantity and Value of Sea Fish (excluding Salmon) returned as landed in 1962 and 1963	27
2.	Comparison of the Average Prices per cwt. of various kinds of Sea Fish for years 1956 to 1963	28
3.	Value of Landings of Sea Fish (excluding salmon) at ports at which the value of such landings exceeded £20,000 in 1963	29
4.	Imports and Exports of Fish and Fishery Products in 1963 (as compared with 1962)	30
5.	Herring Fishing, 1963	31
6.	Mackerel Fishing, 1963	32
7.	Regional Distribution and Classification of Fishing Craft and of Personnel engaged in Fishing in 1963	33
8.	Trawling and Seining, 1963	34
9.	Statement of Account in respect of Repayable Advances	35
10.	Coastal extent of Fishery Districts and names of the Principal Rivers in each District	36
11.	Quantity and Value of all Salmon and Sea Trout taken in 1961, 1962 and 1963 by Instruments of Capture	38
12.	Quantity and Value of Salmon taken in 1961, 1962 and 1963 by Fishery Districts	39
13.	Quantity and Value of Sea Trout taken in 1961, 1962 and 1963 by Fishery Districts	40
14.	Quantity and Value of Eels taken in 1961, 1962 and 1963 by Fishery Districts	41
15.	Total Quantity and Value of Salmon, Sea Trout and Eels taken by all engines in 1961, 1962 and 1963 by Fishery Districts	42
16.	Number, Quantity and Value of Salmon taken by Single Rod and Line in 1961, 1962 and 1963, by Fishery Districts	43
17.	Number, Quantity and Value of Sea Trout taken by Single Rod and Line in 1961, 1962 and 1963, by Fishery Districts	44
18.	Particulars of Receipts and Expenditure of Boards of Conservators for the year ended 30 September, 1963	45
19.	Particulars of Licences issued by Boards of Conservators for the year 1963	46
20.	Licence duties payable on fishing engines	47

Appendix No.		PAGE
21.	Particulars of Public Inquiries held during 1963 ..	48
22.	Abstract of Statutory Instruments, made in 1963 ..	49
23.	Output of Ova in 1962/63	51
24	List of Scientific and other papers, by Officers of Fisheries Division published during 1963	52
25.	A Review of the Dunmore East Herring Investigations 1958–1964, John Bracken Ph.D., Assistant Inspector	53
26.	Donegal Herring Investigations 1963/64. By John Bracken, Ph.D., Assistant Inspector	68
27.	Racial Analyses of Dunmore East Herring Stocks by means of the Otoliths. By M. Foster, Senior Laboratory Assistant	86
28.	Donegal Bay Mackerel Investigations, 1963. By John P. Molloy, B.Sc., Assistant Inspector	95
29.	Mackerel Investigations off the South Coast of Ireland (1962–63). By John P. Molloy, B.Sc., Assistant Inspector	100
30.	Moulting of Lobsters. By F. A. Gibson, Ph.D., Inspector of Fisheries	111
31.	The Effect of Temperature on the Edibility and Keeping Quality of Sea Fish. By Desmond McCarthy, B.A., B.A.I., Assistant Engineer	114
32.	An Advisory Note on the Preserving of Fish by Freezing and Cold Storage. By Desmond McCarthy, B.A., B.A.I., Assistant Engineer	124

Appendices 11 to 17 are compiled from returns furnished by licence holders in pursuance of the Statistics (Salmon, Sea Trout and Eels) (No. 2) Order, 1945.

APPENDIX No. 1

Quantity and value of Sea Fish (excluding salmon) returned as landed in 1962 and 1963

Kinds of Fish	Quantity		Value	
	1963	1962	1963	1962
	cwt.	cwt.	£	£
Soles	3,434	3,495	61,013	57,440
Brill	2,274	2,058	25,114	21,026
Turbot	2,214	1,909	23,678	19,161
Plaice	20,435	19,357	158,227	173,187
Dabs	2,934	3,302	7,906	8,804
Megrims	2,742	2,670	7,860	8,884
Other Flat Fish	1,477	5,279	5,666	8,740
Ray/Skate	26,371	25,695	96,992	92,363
Cod	19,867	18,263	112,516	120,662
Haddock	19,788	8,868	72,531	56,352
Hake	2,496	3,041	18,494	24,014
Whiting	89,039	113,845	182,778	223,857
Pollack	11,027	10,103	38,831	31,938
Other Round Fish	6,220	12,225	17,761	20,119
TOTAL DEMERSAL	210,318	230,110	829,367	866,547
Herrings	165,696	187,534	193,068	260,463
Pilchards	14	5,169	51	2,223
Mackerel	14,980	16,475	33,753	39,297
Sprats	8,272	1,861	3,588	671
TOTAL PELAGIC	188,962	211,039	230,460	302,654
TOTAL WET FISH	399,280	441,149	1,059,827	1,169,201
	Nos.	Nos.		
Lobsters	271,761	296,800	106,101	115,097
Crawfish	82,787	86,975	46,810	56,962
Crabs	47,419	60,853	1,081	1,299
Escallops	474,669	743,427	8,992	12,624
Oysters	1,328,707	1,750,270	22,455	22,360
	cwt.	cwt.		
Dublin Bay Prawns	29,406	16,558	101,094	59,455
Mussels	17,655	6,308	9,291	3,086
Periwinkles	35,988	39,960	54,314	55,868
Other Shellfish	3,168	1,918	3,725	3,043
TOTAL VALUE SHELLFISH	—	—	353,863	329,794
TOTAL VALUE ALL FISH	—	—	1,413,690	1,498,995

APPENDIX No. 2

Comparison of the Average Prices per cwt. of various kinds of Sea Fish for the years 1956-1963

	1956	1957	1958	1959	1960	1961	1962	1963
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Soles ..	12 11 4	15 6 7	14 5 10	14 14 5	14 4 2	15 6 5	16 9 2	17 15 4
Brill ..	9 11 4	9 14 11	8 0 0	9 9 7	9 6 9	10 2 3	10 4 4	11 0 11
Turbot ..	9 15 3	9 2 0	10 7 1	9 16 2	10 2 2	10 0 0	10 0 8	10 13 11
Plaice ..	7 2 3	7 8 9	8 3 6	8 8 8	8 2 8	8 5 1	8 18 11	7 14 10
Dabs ..	—	—	—	—	—	*2 15 3	2 13 3	2 13 11
Megrims ..	—	—	—	—	—	*3 8 3	3 6 6	2 17 4
Ray/Skate ..	2 9 3	2 6 7	2 15 3	3 15 5	3 6 4	3 7 5	3 11 10	3 13 7
Cod ..	4 12 6	4 5 6	4 14 0	5 9 11	5 7 6	6 1 6	6 12 1	5 13 3
Haddock ..	2 5 5	2 2 0	2 17 1	3 5 5	3 16 3	5 5 8	6 7 1	3 13 4
Hake ..	5 17 11	4 17 0	6 9 7	6 19 7	7 12 7	6 0 9	7 17 11	7 8 2
Whiting ..	1 9 2	1 3 4	1 5 3	1 9 4	1 14 8	1 19 11	1 19 4	2 1 1
Pollack ..	—	—	—	—	—	*2 15 1	3 3 2	3 10 5
Herrings ..	0 14 9	0 14 10	1 1 3	1 3 8	0 18 11	0 16 9	1 7 9	1 3 4
Pilchards ..	—	—	—	—	—	*0 7 8	0 8 7	3 12 10
Mackerel ..	1 15 10	1 11 7	1 2 4	1 11 11	1 11 4	1 11 10	2 7 8	2 5 1
Sprats ..	0 10 0	0 5 6	0 6 8	0 7 8	0 13 0	0 7 3	0 7 2	0 8 8

N.B.—"Average price" as shown in this table represents total value divided by total weight for each kind of fish, year by year. It does not purport to take direct cognizance of any abnormal rise or fall in price attributable to a seasonal glut or shortage of a particular kind of fish.

* Comparable figures for years prior to 1961 are not available for these varieties.

APPENDIX No. 3

Value of Landings of Sea Fish (excluding salmon) at ports at which the value of such landings exceeded £20,000 in 1963

Port	Total Value	Demersal	Pelagic	Shellfish
	£	£	£	£
1. Castletownbere ..	220,460	171,278	14,653	34,529
2. Killybegs	176,428	110,454	65,126	848
3. Howth	133,844	128,630	537	4,677
4. Dingle	86,587	62,001	5,389	19,197
5. Dunmore East ..	78,865	473	74,249	4,143
6. Galway	76,120	65,906	1,506	8,708
7. Skerries	54,578	12,659	—	41,919
8. Kilmore Quay ..	48,834	33,872	3,029	11,933
9. Cahirciveen	38,037	37,442	302	293
10. Burtonport	32,964	8,339	22,985	1,640
11. Clogherhead ..	31,537	14,897	3,099	13,541
12. Schull	31,078	19,159	4,749	7,170
13. Union Hall	24,878	19,276	2,524	3,078
14. Balbriggan	23,870	14,259	813	8,798
15. Carna	23,193	87	—	23,106
16. Dun Laoghaire ..	20,364	19,461	—	903

APPENDIX No. 4

IMPORTS AND EXPORTS OF FISH AND FISHERY PRODUCTS IN 1963

(as compared with 1962)

	Quantity		Value	
	1963	1962	1963	1962
I.—IMPORTS	cwt.	cwt.	£	£
Fish, fresh, chilled or frozen	26,209	20,044	172,558	133,046
Fish, cured—not in airtight containers	34,800	30,283	231,932	224,735
Fish and fish preparations in airtight containers ..	22,039	26,506	401,553	568,790
Other fish and fish preparations	6,587	5,053	99,938	76,187
TOTALS	89,635	81,886	905,981	1,002,758
II.—EXPORTS				
Fish, fresh, chilled or frozen :				
Salmon	23,477	18,834	832,458	658,480
Herrings	66,269	112,056	120,912	220,539
Fresh water eels ..	3,125	2,038	45,313	33,772
Other fish	5,776	8,534	64,146	56,339
Fish dried, salted or smoked not in airtight containers	51,106	58,241	178,517	176,216
Shellfish, fresh, chilled, frozen, salted, dried ..	55,703	59,807	442,278	440,588
Other fish and fish preparations	2,084	1,836	35,555	44,222
TOTALS	207,540	261,346	1,719,179	1,630,156

The figures given above for exports of salmon and trout include those relating to exports from the former Moville Fishery District now comprised in the Foyle Area.

APPENDIX No. 5

HERRING FISHING 1963

County	Ports at which more than 500 cwt. were landed	Total Quantity cwt.	Value £
Louth	Clogherhead	2,044	3,249
Dublin ..	Balbriggan	2,520	1,331
Wicklow ..	——	22	56
Wexford ..	——	35	51
Waterford ..	Dunmore East, Passage East	73,183	85,522
Cork	Castletownbere, Kilcrohane, Schull	3,793	8,556
Kerry	Dingle, Sneem	11,132	1,466
Clare	——	—	—
Galway ..	——	257	789
Mayo	Achill	1,050	1,851
Sligo	——	—	—
Donegal ..	Killybegs, Burtonport, Kincasslagh, Bunbeg	71,660	90,197
	TOTALS	165,696	193,068

APPENDIX No. 6

MACKEREL FISHING 1963

County	Ports at which more than 250 cwt. were landed	Total Quantity cwt.	Value £
Louth	—	15	55
Dublin ..	—	10	19
Wicklow ..	—	—	—
Wexford ..	Kilmore Quay	1,352	3,041
Waterford ..	Passage East	575	1,105
Cork	Castletownbere, Schull, Kinsale, Union Hall, Ballycotton, Baltimore	8,979	20,594
Kerry	Dingle	1,930	3,767
Clare	—	233	936
Galway ..	—	290	1,198
Mayo	—	393	915
Sligo	—	65	192
Donegal ..	Killybegs	1,138	1,931
	TOTALS ..	14,980	33,753

APPENDIX No. 7

REGIONAL DISTRIBUTION AND CLASSIFICATION OF FISHING CRAFT AND OF PERSONNEL ENGAGED IN FISHING IN 1963

Coast	How Engaged	Men	Total Vessels	Motor Vessels						Boats propelled by outboard engines, sails or oars	
				Gross Tons						18' Keel and upwards	Less than 18' Keel
				75—120	50—74	25—49	15—24	10—14	Under 10		
EAST (Omeath to Carnsore Point)	Solely	396	142	2	5	56	12	1	14	50	2
	Partially	236	73	—	—	—	1	1	8	60	3
	Laid-up		7	—	—	4	—	—	3	—	—
	Totals	632	222	2	5	60	13	2	25	110	5
SOUTH (Carnsore Point to Loop Head)	Solely	643	308	—	8	55	24	19	77	122	3
	Partially	954	234	—	—	1	—	11	29	101	92
	Laid-up		8	—	—	5	—	1	2	—	—
	Totals	1,597	550	—	8	61	24	31	108	223	95
WEST (Loop Head to Erris Head)	Solely	226	236	—	—	12	5	4	53	125	37
	Partially	1,446	390	—	—	—	—	—	33	169	188
	Laid-up		4	—	—	1	—	1	2	—	—
	Totals	1,672	630	—	—	13	5	5	88	294	225
NORTH (Erris Head to Moville)	Solely	491	283	1	6	25	4	1	79	157	10
	Partially	1,286	245	—	—	—	—	2	35	162	46
	Laid-up		3	—	—	2	—	—	1	—	—
	Totals	1,687	531	1	6	27	4	3	115	319	56
TOTALS (All Coasts)	Solely	1,666	969	3	19	148	45	25	223	454	52
	Partially	3,922	942	—	—	1	1	14	105	492	329
	Laid-up		22	—	—	12	—	2	8	—	—
	Totals	5,583	1,933	3	19	161	46	41	336	946	381

APPENDIX No. 8

TRAWLING AND SEINING 1963

Port or Locality	Number of men engaged	Number of boats engaged	Tonnage of Motor Boats			Fishing Period
			Not exceeding 10 tons	Over 10 tons	Over 15 tons	
Clogherhead	34	8	—	—	8	All year.
Balbriggan	43	9	—	—	9	All year.
Skerries	38	8	—	—	8	All year.
Howth	100	21	—	—	21	All year.
Dublin	8	3	2	—	1	All year.
Dun Laoire	25	5	—	—	5	All year.
Arklow	72	16	—	2	14	All year.
Wexford	16	4	—	2	2	All year.
Kilmore Quay	50	10	—	—	10	All year.
Fethard-on-Sea	5	1	—	—	1	All year.
Duncannon	9	3	3	—	—	All year.
Passage East	15	3	—	—	3	All year.
Dunmore East	35	7	—	—	7	All year.
Helvick	15	3	—	—	3	All year.
Ballycotton	10	3	—	2	1	All year.
Cobh	12	4	4	—	—	All year.
Union Hall and Raheen	39	9	—	3	6	All year.
Schull	32	6	—	—	6	All year.
Castletownbere	68	11	—	—	11	All year.
Ballinskelligs	6	1	—	—	1	All year.
Cahirciveen	15	3	—	—	3	All year.
Dingle	70	14	1	—	13	All year.
Portmagee	20	4	—	—	4	All year.
Liscannor	4	2	2	—	—	Spring, Summer and Autumn.
Galway and Aran Islands	65	13	—	—	13	All year.
Roundstone	2	1	1	—	—	Spring and Autumn.
Cleggan and Inishbofin	16	5	3	1	1	All year.
Murrisk	4	1	—	—	1	All year.
Achill, Keel and Keam	16	4	—	—	4	All year.
Enniscrone	6	3	3	—	—	Spring, Summer and Autumn.
Killybegs	130	23	—	—	23	All year.
Burtonport	40	7	—	—	7	All year.
Kincasslagh	4	1	—	—	1	All year.
Dunfanaghy	2	1	1	—	—	Spring and Autumn.
Downings	4	1	—	—	1	All year.
Buncrana	8	3	2	—	1	All year.
Glengad	32	9	7	2	—	January to October.
Greencastle	38	11	8	1	2	All year.
TOTALS	1,108	241	37	13	191	

APPENDIX No. 9

STATEMENT OF ACCOUNT IN RESPECT OF REPAYABLE ADVANCES

I. Advances of £408,500 made to the Irish Sea Fisheries Association' Ltd., during the period of twenty-one years to 23 April, 1952' for the provision of boats and gear :—

	£
Advances and interest thereon up to 31 March, 1960	566,255
Repayments made to 31 March, 1960	248,281
Amount written off in 1961-62	186,000
Balance of advances to be repaid by a new annuity ..	131,974
	566,255
Instalments of new annuity to accrue up to 1972 ..	160,433
Repayments of new annuity :	
Made to 31 March, 1962	20,054
Made during year ended 31 March, 1963 ..	13,369
not accrued at 31 March, 1963	127,010
	160,433

II. Advances of £63,215 made to Irish Sea Fisheries Association, Ltd., during the period of five years to 23 April, 1952, for purposes other than boats and gear :—

	£
Total repayments to be made, including interest ..	85,973
Repayments	
made to 31 March, 1962	45,814
made during year ended 31 March, 1963 ..	4,278
not accrued at 31 March, 1963	35,881
	85,973

III. Advances of £1,502,563 made to An Bord Iascaigh Mhara during the period of eleven years to 31 March, 1963, for the provision of boats and gear and for other purposes :—

	£
Total repayments to be made, including interest ..	2,547,215
Repayments	
made to 31 March, 1962	493,812
made during year ended 31 March, 1963 ..	116,593
not accrued at 31 March, 1963 .. .	1,936,810
	2,547,215

APPENDIX No. 10

COASTAL EXTENT OF FISHERY DISTRICTS AND NAMES OF THE PRINCIPAL RIVERS IN EACH DISTRICT

District	Coastal Extent of District	Principal Rivers
No. 1 Dublin	Most easterly point on Red Island, Skerries, to Wicklow Head.	Liffey Vartry.
No. 2 Wexford	Wicklow Head to Kiln Bay, east of Bannow Bay, Co. Wexford.	Slaney Avoca.
No. 3 Waterford	Kiln Bay, east of Bannow Bay, to Helvick Head, Co. Waterford.	Suir Barrow Nore.
No. 4 Lismore	Helvick Head to Ballycotton Pier, Co. Cork.	Blackwater, Funshion, Bride, Awbeg.
No. 5 Cork	Ballycotton Pier to Crow Head, Co. Cork.	Lee, Owenboy, Bandon, Argideen, Ilen, Mealagh, Owvane, Coomhola, Glengarriff, Adrigole.
No. 7 Kerry	Crow Head, Co. Cork, to Kerry Head, Co. Kerry.	Roughty, Sheen, Finnihy, Blackwater, Sneem, Laune, Flesk, Maine, Caragh, Currane, Cummeragh, Inny.
No. 8 Limerick	Kerry Head, Co. Kerry, to Hag's Head, Co. Clare.	Shannon, Deel, Fergus, Mulcair, Little and Upper Brosna, Inny, Maigue, Feale.
No. 9[1] Galway	Hag's Head to the sea point of the boundary between the townlands of Keeraunagark Sth. and Banraghbaun Sth., Co. Galway.	Corrib, Claregalway.
No. 9[2] Connemara	The sea point of the boundary between the townlands of Keeraunagark South and Banraghbaun South, Co. Galway, to Slyne Head, Co. Galway.	Ballinahinch, Recess, Cashla, Owengowla, Invermore, Inverbeg, Screebe, Furnace.
No. 10[1] Ballinakill	Slyne Head to Pigeon Point, Westport Bay, Co. Mayo.	Culfin, Errif, Bundorragha, Dawros, Carrowniskey, Bunowen (Louisburgh).
No. 10[2] Bangor	Pigeon Point to Benwee Head, Co. Mayo.	Newport, Burrishoole, Owenduff, Owengarve, Owenmore, Glenamoy.
No. 11 Ballina	Benwee Head to Coonamore Point, Co. Sligo.	Moy, Cloonaghmore (Palmerston), Easkey.

District	Coastal Extent of District	Principal Rivers
No. 12 Sligo	Coonamore Point to Carrickgarve, Co. Sligo.	Ballisodare, Garavogue (Sligo), Bonet, Drumcliff.
No. 13 Ballyshannon	Carrickgarve to Rossan Point, Co. Donegal.	Erne, Bundrowes, Bunduff, Eske, Eaney Water, Oily, Glen.
No. 14[1] Letterkenny	Rossan Point to Malin Head, Co. Donegal.	Owenea, Gweebarra, Gweedore (Crolly), Clady, Lackagh, Lennon, Crana.
No. 17[2] Dundalk	Carlingford Lough to Clogherhead, Co. Louth.	Fane, Dee, Glyde.
No. 17[1] Drogheda	Clogherhead to the most easterly point on Red Island, Skerries, Co. Dublin.	Boyne, Blackwater, Deel.

Note—The area comprised in the former No. 14[2] or Moville District was, by the Foyle Fisheries Act, 1952, incorporated in the Foyle Area which is administered by the Foyle Fisheries Commission.

APPENDIX No. 11

Quantity and Value of all Salmon and Sea Trout taken in 1961, 1962 and 1963 by Instruments of Capture.

SALMON

Instruments	1963	1962	1961	1963	1962	1961
Total for all engines	lb. 2,836,640	lb. 2,863,868	lb. 1,345,653	£ 703,217	£ 620,467	£ 410,381
Total for rod and line	341,539	257,579	193,376	101,101	74,356	65,023
Total for drift nets	687,159	606,806	218,248	143,771	114,851	58,255
Total for draft nets	1,395,945	1,622,645	741,305	348,028	347,135	225,698
Total for stake nets, weirs, etc.	411,997	376,838	192,724	110,317	84,125	61,405

SEA TROUT

Instruments	1963	1962	1961	1963	1962	1961
Total for all engines	lb. 91,681	lb. 90,380	lb. 90,102	£ 15,231	£ 15,034	£ 14,648
Total for rod and line	64,835	63,034	64,127	9,946	9,701	9,608
Total for drift nets	838	1,437	1,188	167	274	266
Total for draft nets	21,908	23,442	22,955	4,226	4,622	4,399
Total for stake nets, weirs, etc.	4,100	2,467	1,832	892	437	375

This Appendix does not include returns from the former Moville Fishery District

APPENDIX No. 12

Quantity and Value of Salmon taken in 1961, 1962 and 1963, by Fishery Districts.

Fishery District	*	Quantity			Value		
		1963 lb.	1962 lb.	1961 lb.	1963 £	1962 £	1961 £
Dublin	R	4,128	2,395	2,095	1,409	913	948
	N	7,161	8,672	2,741	1,922	1,862	926
Wexford	R	29,567	11,946	9,834	9,505	4,394	3,550
	N	43,894	21,643	19,596	15,785	7,544	7,885
Waterford	R	43,236	32,782	22,289	12,696	9,804	8,277
	N	371,890	359,643	133,362	84,416	63,856	40,959
Lismore	R	39,863	27,500	22,110	11,542	7,670	6,947
	N	259,826	249,589	95,806	64,611	49,561	31,570
Cork	R	28,883	17,462	9,404	9,818	5,653	3,498
	N	87,077	75,755	35,794	22,200	15,863	10,779
Kerry	R	46,437	29,881	21,396	13,309	7,967	6,760
	N	267,511	305,602	119,555	62,374	56,359	36,674
Limerick	R	47,817	43,469	37,436	13,968	13,894	12,943
	N	358,956	373,451	141,236	84,463	94,910	42,992
Galway	R	7,681	4,632	3,250	2,167	1,181	1,127
	N	52,661	57,762	20,455	15,150	13,653	6,184
Connemara	R	4,842	7,303	3,362	1,270	1,976	1,025
	N	Nil	Nil	Nil	Nil	Nil	Nil
Ballinakill	R	7,412	6,517	2,484	2,097	1,232	779
	N	28,225	48,477	12,454	5,469	7,861	2,828
Bangor	R	12,140	6,597	7,564	3,500	1,909	2,254
	N	80,172	143,098	58,328	15,818	27,480	14,041
Ballina	R	17,586	27,562	20,396	4,519	6,598	5,902
	N	374,039	397,668	256,283	84,372	87,900	73,675
Sligo	R	8,112	5,777	6,583	2,203	1,758	2,269
	N	61,969	85,023	44,773	14,323	19,926	12,655
Ballyshannon	R	5,797	6,951	3,812	1,731	1,493	1,351
	N	96,450	144,267	43,411	20,724	24,325	11,769
Letterkenny	R	17,782	13,220	12,145	4,711	3,087	3,571
	N	212,673	211,438	100,345	42,657	37,432	24,245
Dundalk	R	6,995	4,004	1,472	2,017	998	533
	N	70,250	51,365	23,599	17,316	10,945	7,507
Drogheda	R	13,261	9,581	7,744	4,639	3,829	3,289
	N	122,347	72,836	44,539	50,516	26,634	20,669
TOTALS		2,836,640	2,863,868	1,345,653	703,217	620,467	410,381

* R. indicates capture by means of single rod and line ; N by means of nets, weirs, etc.

APPENDIX No. 13

Quantity and Value of Sea Trout taken in 1961, 1962 and 1963, by Fishery Districts.

Fishery District	*	Quantity			Value		
		1963 lb.	1962 lb.	1961 lb.	1963 £	1962 £	1961 £
Dublin ..	R	1,267	2,421	1,098	207	428	214
	N	3,716	4,146	4,992	846	916	1,028
Wexford ..	R	968	2,242	2,006	138	420	293
	N	3,345	3,755	4,658	509	632	652
Waterford ..	R	788	526	932	109	134	135
	N	428	566	691	39	80	83
Lismore ..	R	658	1,346	749	105	262	100
	N	1,687	1,347	1,866	251	183	320
Cork ..	R	7,398	4,937	7,255	1,069	687	1,028
	N	2,427	374	961	384	58	169
Kerry ..	R	12,098	10,707	13,294	1,839	1,583	1,794
	N	4,165	2,777	1,647	875	459	377
Limerick ..	R	5,784	6,627	5,513	864	980	791
	N	5,191	8,311	4,956	1,428	2,006	1,278
Galway ..	R	3,041	1,751	1,568	487	268	262
	N	239	515	504	39	60	103
Connemara ..	R	11,319	11,679	12,765	1,803	1,718	2,018
	N	Nil	Nil	Nil	Nil	Nil	Nil
Ballinakill ..	R	4,891	4,870	3,305	777	722	473
	N	910	916	740	124	145	104
Bangor ..	R	6,508	5,578	7,250	988	838	1,106
	N	843	657	1,585	119	122	311
Ballina ..	R	1,232	1,287	1,220	171	222	240
	N	74	89	236	13	11	30
Sligo ..	R	654	545	262	108	85	46
	N	240	360	184	48	72	35
Ballyshannon ..	R	1,572	1,717	1,143	251	330	170
	N	299	497	513	41	53	84
Letterkenny ..	R	3,713	3,046	3,239	537	427	512
	N	486	442	393	74	63	57
Dundalk ..	R	1,032	2,107	650	154	325	103
	N	2,196	1,063	714	375	186	129
Drogheda ..	R	1,912	1,648	1,878	339	272	323
	N	600	1,531	1,335	120	287	280
TOTALS ..		91,681	90,380	90,102	15,231	15,034	14,648

*R. indicates capture by means of single rod and line ;
N. by means of nets, weirs, etc.

APPENDIX No. 14

Quantity and Value of Eels taken in 1961, 1962 and 1963, by Fishery Districts.

Fishery District	Quantity			Value		
	1963 lb.	1962 lb.	1961 lb.	1963 £	1962 £	1961 £
Wexford ..	33,200	Nil	4,563	3,662	Nil	610
Waterford ..	7,576	8,035	6,513	702	750	477
Lismore ..	Nil	160	220	Nil	12	21
Cork ..	Nil	Nil	1,800	Nil	Nil	80
Limerick ..	73,934	131,021	109,770	12,851	16,774	13,926
Galway ..	43,928	48,731	61,431	7,267	7,070	7,454
Ballina ..	2,763	3,373	7,937	332	501	943
Sligo ..	8,065	2,505	30,790	1,557	239	2,344
Ballyshannon ..	12,000	12,628	4,842	1,749	1,347	521
Dundalk ..	28,511	12,142	5,002	4,193	1,263	580
Drogheda ..	21,723	8,492	3,339	2,484	1,260	408
TOTALS ..	231,700	227,087	236,207	34,797	29,216	27,364

NOTE : The catch figures set out above are based on returns which are not complete. This explains any apparent inconsistency between the figures and the official export figures in any particular year.

APPENDIX No. 15

Total Quantity and Value of Salmon, Sea Trout and Eels taken by all engines in 1961, 1962 and 1963 by Fishery Districts.

Fishery District	Total Weight for District			Total Value for District		
	1963 lb.	1962 lb.	1961 lb.	1963 £	1962 £	1961 £
Dublin ..	16,272	17,634	10,926	4,384	4,119	3,116
Wexford ..	110,974	39,586	40,657	29,599	12,990	12,990
Waterford ..	423,918	401,552	163,787	97,962	74,624	49,931
Lismore ..	302,034	279,942	120,751	76,509	57,688	38,958
Cork ..	125,785	98,528	55,214	33,471	22,261	15,554
Kerry ..	330,211	348,967	155,892	78,397	66,368	45,605
Limerick ..	491,682	562,879	298,911	113,574	128,564	71,930
Galway ..	107,550	113,391	87,208	25,110	22,232	15,130
Connemara ..	16,161	18,982	16,127	3,073	3,694	3,043
Ballinakill ..	41,438	60,780	18,983	8,467	9,960	4,184
Bangor ..	99,663	155,930	74,727	20,425	30,349	17,712
Ballina ..	395,694	429,979	286,072	89,407	95,232	80,790
Sligo ..	79,040	94,210	82,592	18,239	22,080	17,349
Ballysbannon ..	116,118	166,060	53,721	24,496	27,548	13,895
Letterkenny ..	234,654	228,146	116,122	47,979	41,009	28,385
Dundalk ..	108,984	70,681	31,437	24,055	13,717	8,852
Drogheda ..	159,843	94,088	58,835	58,098	32,282	24,969
TOTALS ..	3,160,021	3,181,335	1,671,962	753,245	664,717	452,393

APPENDIX No. 16

Number, Quantity and Value of Salmon taken by Single Rod and Line in 1961, 1962 and 1963, by Fishery Districts.

Fishery District	No. of Fish			Quantity			Value		
	1963	1962	1961	1963	1962	1961	1963	1962	1961
				lb.	lb.	lb.	£	£	£
Dublin ..	469	315	221	4,128	2,395	2,095	1,409	913	948
Wexford ..	3,011	1,442	982	29,567	11,946	9,834	9,505	4,394	3,550
Waterford ..	5,047	4,164	2,534	43,236	32,782	22,289	12,696	9,804	8,277
Lismore ..	4,261	3,315	2,747	39,863	27,500	22,110	11,542	7,670	6,947
Cork ..	3,384	2,223	1,143	28,883	17,462	9,404	9,818	5,653	3,498
Kerry ..	6,109	4,248	2,974	46,437	29,881	21,396	13,309	7,967	6,760
Limerick ..	5,736	5,805	4,650	47,817	43,469	37,436	13,968	13,894	12,943
Galway ..	1,067	729	524	7,681	4,632	3,250	2,167	1,181	1,127
Connemara ..	698	1,057	553	4,842	7,303	3,362	1,270	1,976	1,025
Ballinakill ..	1,009	960	434	7,412	6,517	2,484	2,097	1,232	779
Bangor ..	1,333	922	1,364	12,140	6,597	7,564	3,500	1,909	2,254
Ballina ..	2,501	3,990	3,296	17,586	27,562	20,396	4,519	6,598	5,902
Sligo ..	1,007	810	940	8,112	5,777	6,583	2,203	1,758	2,269
Ballyshannon	714	971	494	5,797	6,951	3,812	1,731	1,493	1,351
Letterkenny	2,182	2,013	1,710	17,782	13,220	12,145	4,711	3,087	3,571
Dundalk ..	730	504	163	6,995	4,004	1,472	2,017	998	533
Drogheda ..	1,136	803	620	13,261	9,581	7,744	4,639	3,829	3,289
TOTALS	40,394	34,271	25,349	341,539	257,579	193,376	101,101	74,356	65,023

APPENDIX No. 17

Number, Quantity and Value of Sea Trout taken by Single Rod and Line in 1961, 1962 and 1963, by Fishery Districts.

Fishery District	No. of Fish			Quantity			Value		
	1963	1962	1961	1963	1962	1961	1963	1962	1961
				lb.	lb.	lb.	£	£	£
Dublin ..	1,662	2,421	1,234	1,267	2,421	1,098	207	428	214
Wexford ..	1,240	2,485	2,561	968	2,242	2,006	138	420	293
Waterford ..	835	663	1,093	788	526	932	109	134	135
Lismore ..	603	555	683	658	1,346	749	105	262	100
Cork ..	8,575	5,141	8,349	7,398	4,937	7,255	1,069	687	1,028
Kerry ..	10,826	8,404	9,902	12,098	10,707	13,294	1,839	1,583	1,794
Limerick ..	6,453	7,703	7,024	5,784	6,627	5,513	864	980	791
Galway ..	3,053	1,699	1,607	3,041	1,751	1,568	487	268	262
Connemara	10,779	10,868	13,928	11,319	11,679	12,765	1,803	1,718	2,018
Ballinakill ..	4,581	4,285	3,139	4,891	4,870	3,305	777	722	473
Bangor ..	6,898	5,750	7,174	6,508	5,578	7,250	988	838	1,106
Ballina ..	1,170	1,121	1,210	1,232	1,287	1,220	171	222	240
Sligo ..	678	448	212	654	545	262	108	85	46
Ballyshannon	1,537	1,117	1,041	1,572	1,717	1,143	251	330	170
Letterkenny	4,168	3,395	3,028	3,713	3,046	3,239	537	427	512
Dundalk ..	968	2,058	598	1,032	2,107	650	154	325	103
Drogheda ..	1,649	1,795	2,140	1,912	1,648	1,878	339	272	323
TOTALS	65,675	59,908	64,914	64,835	63,034	64,127	9,946	9,701	9,608

APPENDIX No. 18

PARTICULARS OF RECEIPTS AND EXPENDITURE OF BOARDS OF CONSERVATORS FOR THE YEAR ENDED 30 September, 1963

Fishery District	RECEIPTS						EXPENDITURE					
	Opening Balance	Licence Duty	Fishery Rate	Grant from Department	Miscellaneous Receipts	Total Receipts	Salaries	Water Keepers	Law Costs	Travelling and Miscellaneous	Total Expenditure	Closing Balance
	£	£	£	£	£	£	£	£	£	£	£	£
Dublin ..	+ 56	1,810	281	800	331	3,222	1,247	348	7	1,384	2,986	+ 292
Wexford ..	+ 269	1,497	1,724	400	275	3,896	779	1,629	—	1,461	3,869	+ 296
Waterford ..	+ 380	3,271	2,435	5,500	223	11,429	1,549	5,507	262	3,918	11,236	+ 573
Lismore ..	+ 77	1,509	6,372	3,000	235	11,116	1,026	6,826	310	2,080	10,242	+ 951
Cork ..	+ 2,143	2,291	1,073	3,200	207	6,771	924	4,369	92	1,869	7,254	+ 1,660
Kerry ..	+ 2,235	3,162	3,225	1,400	320	8,107	1,184	4,354	142	2,085	7,765	+ 2,577
Limerick ..	+ 3,226	3,862	3,804	6,800	3,352	17,818	1,325	8,813	479	5,943	16,560	+ 4,484
Galway ..	+ 1,776	1,178	2,920	800	439	5,337	2,340	1,030	1	2,089	5,460	+ 1,653
Connemara ..	+ 337	715	1,766	—	43	2,524	378	1,492	—	512	2,382	+ 479
Ballinakill ..	— 354	595	1,505	800	280	3,180	386	1,472	7	860	2,725	+ 101
Bangor ..	+ 659	1,013	1,488	800	438	3,739	1,103	1,877	160	1,226	4,366	+ 32
Ballina ..	— 466	1,039	3,888	250	343	5,520	681	3,634	177	975	5,467	— 413
Sligo ..	+ 587	625	994	—	167	1,786	400	837	43	601	1,881	+ 492
Ballyshannon ..	+ 592	921	572	3,604	151	5,248	707	3,056	150	1,623	5,536	+ 304
Letterkenny ..	+ 1,328	2,435	1,845	238	234	4,752	767	2,990	70	961	4,788	+ 1,292
Drogheda ..	+ 334	1,762	1,641	2,200	171	5,774	706	2,758	152	1,920	5,536	+ 572
Dundalk ..	+ 368	999	321	1,700	86	3,106	416	961	857	784	3,018	+ 456
TOTALS ..	+ 13,547	28,684	35,854	31,492	7,295	103,325	15,918	51,953	2,909	30,291	101,071	+ 15,801

APPENDIX No. 19

PARTICULARS OF LICENCES ISSUED BY BOARDS OF CONSERVATORS FOR THE YEAR 1963

Fishery District	Salmon Rod																						
	Annual (all districts)	Annual (district of issue)	Late season (all districts)	Twenty-one day (all districts)	Seven day (all districts)	Late season (district of issue)	Foyle Area extension (one district)	Foyle Area extension (all districts)	Special Local Licences (Tidal Waters)	Draft Net	Drift Net	Pole Net	Bag Net	Stake Net	Head Weir	Box or Crib	Loop Net	Snap Net	Gap Eye or Basket for Eels	Long Line for Eels	Oyster Dredge	Eel Trap	Fyke Net for Eels
Dublin ..	322	65	32	—	58	35	—	1	—	11	19	—	—	—	—	—	—	—	—	—	—	—	—
Wexford ..	128	105	—	—	185	69	—	—	—	84	—	1	—	—	—	—	—	—	—	—	—	1	30
Waterford ..	90	654	9	—	54	22	—	—	—	16	97	—	1	3	1	3	—	124	6	1	—	—	—
Lismore ..	67	217	6	—	246	—	—	—	—	12	58	—	—	2	—	1	—	13	1	—	—	—	—
Cork ..	191	270	22	—	255	104	—	—	—	38	12	—	—	—	—	—	—	—	—	—	—	—	—
Kerry ..	146	257	9	—	714	269	1	—	—	59	—	—	—	—	—	3	—	—	—	—	12	—	—
Limerick ..	149	712	5	—	85	64	—	—	—	105	76	—	—	4	—	4	—	—	32	15	—	—	—
Galway ..	62	47	41	—	238	57	—	—	—	10	—	—	—	—	—	5	—	—	23	8	81	—	—
Connemara ..	13	8	3	—	358	136	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Ballinakill ..	13	21	17	—	206	80	—	1	—	15	—	—	—	—	—	—	—	—	—	—	—	—	—
Bangor ..	60	29	14	—	273	98	2	—	—	34	4	—	2	—	—	—	—	—	2	—	—	—	—
Ballina ..	48	97	10	1	115	25	—	—	—	13	56	—	—	—	—	7	—	—	31	3	—	—	—
Sligo ..	53	96	6	—	35	7	—	—	—	6	4	—	1	—	—	—	—	—	2	4	—	—	—
Ballyshannon ..	34	56	2	—	117	26	26	23	6	57	11	—	—	—	—	1	—	—	8	14	—	—	—
Letterkenny ..	49	297	2	1	276	109	138	46	11	39	57	—	—	—	—	2	22	—	—	2	—	—	—
Drogheda ..	180	106	3	—	25	12	—	—	—	143	—	—	—	—	—	6	—	—	2	2	—	13	—
Dundalk ..	70	95	1	—	26	65	57	15	—	30	—	—	—	—	—	—	—	—	13	2	—	1	—
TOTALS ..	1,675	3,132	182	2	3,266	1,178	224	86	17	672	394	1	4	9	1	32	22	137	120	51	93	15	30

APPENDIX No. 20

Licence Duties Payable on Fishing Engines

	£	s.	d.
On each Salmon Rod—Annual (valid all districts) ...	4	0	0
Do. Salmon Rod—Late Season (valid all districts)	3	0	0
Do. Salmon Rod—Twenty-one day (valid all districts)	3	0	0
Do. Salmon Rod—Seven day (valid all districts) ...	1	0	0
Do. Salmon Rod—Annual (valid district of issue only)	3	0	0
Do. Salmon Rod—Late Season (valid district of issue only)	2	0	0
Do. Salmon Rod—Foyle area extension (valid all districts)	2	10	0
Do. Salmon Rod—Foyle area extension (valid district of issue only)	1	10	0
On each—Draft net	4	0	0
Do. —Drift net	3	0	0
Do. —Snap net	2	10	0
Do. —Bag net	10	0	0
Do. —Stake net	30	0	0
Do. —Head Weir	6	0	0
Do. —Box or Crib	10	0	0
Do. —Gap, Eye, Basket or Coghill Net for Eels ...	2	0	0
Do. —Long line for Eels	2	0	0
Do. —Oyster fishing engine	2	0	0

Licence Duties Payable on Fishing Engines other than those Mentioned Above

Fishery District	Pole Net	Loop Net	Eel Trap	Special Local Licences	
				Rod	Draft Net
	£ s.	£ s.	£ s.	£ s.	£ s.
1. Dublin	2 0	—	—	—	—
2. Wexford	2 0	—	—	—	—
3. Waterford	2 0	—	—	—	—
4. Lismore	2 0	—	—	—	—
5. Cork	2 0	—	—	—	—
7. Kerry	2 0	—	—	—	—
8. Limerick	2 0	—	—	—	—
9. Galway	2 0	—	15 0	—	—
9[2]. Connemara	2 0	—	—	—	—
10[1]. Ballinakill	2 0	—	—	—	—
10[2]. Bangor	2 0	—	—	—	—
11. Ballina	2 0	—	—	—	—
12. Sligo	2 0	—	—	—	—
13. Ballyshannon	2 0	—	2 0	*3 0	*25 0
14[1]. Letterkenny	2 0	0 10	—	‡3 0	†12 10 ‡20 0
17[1]. Drogheda	2 0	0 10	2 0	—	—
17[2]. Dundalk	2 0	—	—	—	—

‡ River Lackagh Tidal Waters. * River Erne Tidal Waters.
† River Owenea Tidal Waters.

APPENDIX No. 21

PARTICULARS OF PUBLIC INQUIRIES HELD DURING 1963

Date of Inquiry	Where held	Subject Matter	Decision on Report of Inquiry
13 March, 1963	Goleen	Application of Mr. Rickard Collins, Rock Island, Goleen, for oyster fishery order.	Order granted.
13 March, 1963	Goleen	Application of Mr. Patrick O'Sullivan, Crookhaven, for oyster fishery order.	Order granted.
26 June, 1963	Wexford	Application for a bye-law regulating the use of nets, including trammel nets, in the sea or in the tideway of any estuary in the Wexford fishery district.	Bye-law to be made.
16 July, 1963	Carlingford	Application of Verwijs Oyster Farm Ltd., 20/21 Moore Street, Dublin, for oyster fishery order.	Order refused.
11 December, 1963	Cork	Restrictions on salmon fishing in the River Lee and in Cork Harbour.	Bye-law to be made.
19 December, 1963	Tullow	(*a*) Angling with lures other than artificial fly in River Slaney (*b*) Close season for angling for trout in River Slaney.	Bye-law to be made.

APPENDIX No. 22

ABSTRACT OF STATUTORY INSTRUMENTS MADE IN 1963

GENERAL

Fisheries (Delegation of Ministerial Functions) Order, 1963 (S.I. No. 40 of 1963), made by the Government on 5 March, 1963.

DELEGATING to the Parliamentary Secretary to the Minister for Lands the powers and duties of the Minister for Lands under the Fisheries (Amendment) Act, 1962.

Fishing Nets (Regulation of Mesh) (Amendment) Order, 1963 (S.I. No. 47 of 1963), dated 26 March, 1963.

PERMITTING up to 1 June, 1964, the use of certain fishing nets having a smaller mesh than that specified in 1954.

Undersized Sea-fish (Lobsters) Order, 1963 (S.I. No. 52 of 1963), dated 5 April, 1963.

DECLARING a new minimum size limit for lobsters from 1 May, 1963.

Fisheries (Delegation of Ministerial Functions) (No. 2) Order, 1963 (S.I. No. 187 of 1963), made by the Government on 8 October, 1963.

DELEGATING to the Parliamentary Secretary to the Minister for Lands the powers and duties of the Minister for Lands in relation to fisheries under the Sea Fisheries (Amendment) Act, 1963, and the Finance Act, 1963.

Fisheries (Consolidation) Act, 1959 (Salmon Dealer's Licence) Regulations, 1963 (S.I. No. 228 of 1963), dated 18 November, 1963.

PRESCRIBING a new form of application for a salmon dealer's licence.

LOCAL

Ballyshannon District Bye-law No. 511, 1963, dated 20 February, 1963.

PROHIBITING all fishing for salmon and trout with any fishing engine other than rod and line in the tidal waters of the River Erne or of its tributary the Abbey River during each of the years 1963, 1964 and 1965.

River Slaney (Angling) Bye-law No. 512, 1963, dated 27 February, 1963.

PROHIBITING, during specified periods, angling in which any lure other than artificial fly is employed within defined portions of the River Slaney.

Oyster Fishery (Cork Harbour) Order, 1963, dated 8 March, 1963.

GRANTING to the Shannon Oyster Company Limited, 72 St. Stephen's Green, Dublin, the exclusive right of depositing, propagating, dredging and fishing for and taking oysters in that part of Cork Harbour described in the Schedule to the Order.

Licence to form or plant an Oyster Bed, No. 187, dated 17 July, 1963.

GRANTING, under specified conditions, a licence to Mr. John Malone of Ballyerra, Kilrush, Co. Clare, to form or plant an oyster bed in that part of the Shannon estuary shown on the map annexed to the licence.

River Erne (Special Local Licences) (Amendment) Order, 1963 (S.I. No. 147 of 1963), dated 31 July, 1963.

PROVIDING that the special local licence duty payable in respect of a draft net for use in the tidal waters of the River Erne shall be £5.

Ballyshannon District Netting Bye-law No. 513, 1963, dated 2 August, 1963.

PERMITTING the use of draft nets not exceeding 85 yards in length for taking salmon or trout during the period from 2 to 19 August, 1963, in the portions of the tidal waters of the River Erne and Abbey River specified in the bye-law, notwithstanding the prohibitions contained in the Ballyshannon District Bye-law No. 511, 1963.

Oyster Fishery (Crook Haven) Order, 1963, dated 16 October, 1963.

GRANTING to Rickard Collins of Rock Island, Goleen, Co. Cork, the exclusive right of depositing, propagating, dredging and fishing for and taking oysters in that part of Crook Haven described in the Schedule to the Order.

Oyster Fishery (Crook Haven) (No. 2) Order, 1963, dated 16 October, 1963.

GRANTING to Patrick O'Sullivan of Crookhaven, Co. Cork, the exclusive right of depositing, propagating, dredging and fishing for and taking oysters in that part of Crook Haven described in the Schedule to the Order.

APPENDIX No. 23

OUTPUT OF OVA IN 1962/63

	River system stocked	Salmon ova ('000)	Sea Trout ova ('000)	Brown Trout ova ('000)
Lismore ..	290,000 ova to hatching stations throughout the State, remainder to River Blackwater	340	—	—
Mallow ..	River Blackwater and tributaries	1,250	—	—
Inistioge ..	River Nore and tributaries ..	75	—	—
Loughrea ..	Lough Rea	—	—	1,136
Parteen ..	Shannon	1,212	—	—
Fanure ..	Various Trust Waters ..	—	—	1,155
Clooncrim ..	Tributaries Lough Corrib, River Suck and tributaries	—	—	275
Mullingar ..	Loughs Ennell, Owel, Derrevarragh, Castlebar lakes and tributaries	—	—	1,275
Sheelin ..	Lough Sheelin and tributaries ..	—	—	200
Oughterard ..	Lough Corrib and tributaries and River Suck System ..	—	—	280
Screebe ..	Screebe River	284	115	—
Ballisodare ..	Ballisodare River and tributaries	73	—	—
Ballyshannon	Erne	759	—	—
Lee ..	Lee	100	—	—
Glenties ..	496,000 salmon ova distributed to hatching stations throughout the State ; remainder to Rivers Owenea and Owentocker. All seatrout ova supplied to Inland Fisheries Trust and fry released in Trust Waters	803	45	—
	TOTALS ..	4,896	160	4,321

APPENDIX No. 24

LIST OF SCIENTIFIC AND OTHER PAPERS BY OFFICERS OF THE FISHERIES DIVISION PUBLISHED DURING THE YEAR 1963 (OTHER THAN THOSE APPENDED TO THIS REPORT)

MORIARTY, CHRISTOPHER, Food of Perch (*Perca fluviatilis*, L.) and trout (*Salmo trutta*, L.) in an Irish reservoir. *Proc. Roy. Irish Acad.* 63 *B*.1.

TWOMEY, EILEEN AND ANN O'RIORDAN, Movements of salmon around Ireland. IX. From Ardmore, Co. Waterford (1958-1961). *Proc. Roy. Irish Acad.* 63 *B*.5.

WENT, ARTHUR, E. J. Salmon and Sea trout of the River Foyle (1962) 11*th Rep. Foyle Fish Com.* pp. 39-43.

————————Tagging experiments. 11*th Rep. Foyle Fish Com.* pp. 43-49.

————————Rare fishes taken in Irish waters in 1962. *Irish Nat. Jour.* XIV. pp. 105-108.

APPENDIX No. 25

A REVIEW OF THE DUNMORE EAST HERRING INVESTIGATIONS (1958-1964)

by

JOHN BRACKEN, PH.D., Assistant Inspector

THE HISTORY OF THE FISHERY.—Watkin (1933b) and Farran (1946) have described the drift-net fishery for herrings which took place annually off the south coast of Ireland in the spring and early summer from 1921 to 1932. English drifters, mainly from Yarmouth and Lowestoft, turned to this fishery after the close of the east Anglian season. These vessels, based at Dunmore East, fished an area extending from ten to forty miles offshore, mainly in a south-westerly direction from Old Head of Kinsale in an area known as the Labodie Bank (Fig. 1). The herring shoals at this time were composed of recovering spents which were feeding heavily. The existence of a winter spawning stock off Dunmore East was known during this period (1921 to 1932) but this stock was not fished to any great extent. However, from around 1933 the British boats began to concentrate on the Dunmore East grounds more in December and January, when full, spawning and spent herrings were taken, than in the spring/summer drift-net fishery hitherto engaged in.

In addition, a trawl fishery took place in the Smalls area in late summer when fish in maturity stages IV and V (filling and full) were taken (Watkin, 1933a). As no evidence of spawning was found, Watkin suggested that these fish left the Smalls to spawn elsewhere. A study of the available catch/effort statistics from the pre-war winter and spring drift-net fisheries off the south coast of Ireland and the summer trawl fishery in the Smalls area was made by Hickling (1946). He found that a correlation existed between the maturity stages of each fishery and concluded that they were based on the same stock. Gilis (1953, 1956 and 1958) working on Belgian trawl catch data for the Smalls has confirmed the observations of Watkin and Hickling. From 1940 to 1954 fishing in the Dunmore area was undertaken almost exclusively by Irish vessels. Following the decline of the North Sea stocks international interest was again aroused in the Dunmore fishery from 1955 onwards and Irish, British, Dutch, German, French and Belgian vessels attended this fishery from 1955 to 1960.

In 1959 the Herring Committee of the International Council for the Exploration of the Sea formed a Working Group to examine all the available biological data from the Dunmore East herring fishery. The Group was composed of representatives from the Federal Republic of Germany, Great Britain, the Netherlands and Ireland. In May, 1960, the results obtained by the participating countries were discussed in detail. The principal features of the investigations and of the conclusions reached were summarised under the following headings:—

(1) Development of the fishery

(2) Unity of stock

(3) Larval and whitebait studies

(4) The dynamics of the stock

(5) Future work.

By reason of the introduction of straight baselines for the Irish exclusive fishery limits in January, 1960, the Working Group felt that the international character of the Dunmore herring fishery might be limited from the 1960/61 season onwards and that consequently the biological and dynamic data in relation to the fishery might thence-forward have to come almost entirely from Irish sources. On this basis the following programme or work was drawn up by the Working Group:—

(1) Beach-seining during the summer and autumn on the south, south-east and east coasts of Ireland;

(2) Sampling of adult herrings each season;

(3) Tin-tow net surveys for herring larvae.

It must be borne in mind that the Irish herring investigations commenced in November, 1958, before the formation of the Dunmore Working Group and were confined, in the initial stages, to sampling catches of adult herrings landed at Dunmore East by Irish vessels. These investigations were continued during the next five seasons and were extended to cover all the recommendations made by the Working Group.

POSITION AND EXTENT OF THE DUNMORE FISHERY DURING THE 1958-64 PERIOD.—In the 1958/59 season foreign vessels first located the shoals in November 1958, 12 to 20 miles offshore, in a south-easterly direction from the Coningsbeg light-ship. The herrings moved rapidly inshore and before Christmas Irish boats fished an area west of the Hook; heavy landings were made within 12 miles of the Hook itself. Only light landings were made before Christmas east of the Hook. All catches made by Irish boats after Christmas were in an area extending from the Hook to the Saltees, comparatively close inshore in Baginbun Bay.

No information as to where precisely the foreign vessels fished could be obtained but it is assumed that they fished mainly within about 10 to 12 miles of the Irish coastline.

The 1959/60 season opened in late October and the shoals were located south-west of the Saltees, close inshore in 12 to 20 fathoms. By mid-November the fish were mainly north-east of the Hook but were also located in Waterford Harbour and heavy landings were made off Hall's Point up to Christmas. Again, after Christmas, fishing was confined mainly to Baginbun Bay as in the previous season, some light landings being made off Brownstown Head in early

January. At the close of the season, in mid-February, the shoals were located off the Keraghs. The position and extent of the fishery in the 1960/61 and 1961/62 seasons was similar to that in the 1959/60 season (Fig. 2).

In 1962/63 and 1963/64 the pattern changed considerably from that which had obtained since 1959. During these two seasons the estuarine fishing was of much shorter duration than theretofore. Fishing for the greater part of the seasons was much further offshore than usual. Irish boats fished up to 12 miles off the Hook. During the 1962/63 season the shoals had moved in a westerly direction in January and were taken in 30 to 36 fathoms off Mine Head, Co. Waterford. Towards the latter part of January, 1964, the shoals were 6 to 10 miles off the Hook but were subsequently fished heavily in Baginbun Bay prior to spawning.

LANDINGS, BOATS AND GEAR USED.—A summary of the total landings from 1921 to 1964 is given in Table 1 which shows the Irish landings for the whole period and, in addition, from 1951 onwards, landings of all other participating countries. The landings by the foreign vessels for the 1962/63 and 1963/64 seasons are incomplete and have been omitted. It may be seen that these stocks were heavily fished during the 1957/58 and 1958/59 seasons by large fleets of foreign vessels. From January, 1960, when the Irish exclusive fishery limits were measured from straight baselines foreign interest in the fishery waned as the extent of the grounds which foreign boats could fish was curtailed.

Since the 1958/59 season monthly landings per season at Dunmore East have been recorded (Table 2). These figures have been further broken down into monthly landings per type of gear (Table 3). The latter Table reveals an interesting change in the pattern of landings per type of gear over the six seasons. While in the 1958/59 and 1959/60 seasons ring nets landed the major part of the catches, thereafter they accounted for a diminishing proportion of the catches until in the 1962/63 and 1963/64 seasons the catch by this type of gear constituted only a very small share of the total. In each of the seasons 1958/59 to 1960/61 the pre-Christmas landings by ring-nets were dominant while after Christmas the proportion taken by ring-nets decreased and that by other types of gear (mainly trawls) increased. This is thought to be related to the maturities of the fish, for with the onset of spawning after Christmas the shoals tend to mass close to the bottom and are therefore more easily taken by the trawlers.

The numbers of Irish boats and the type of gear used during the Dunmore season for the period 1958 to 1964 are given in Table 4. The numbers of ring-nets declined drastically after the 1960/61 season and reached their lowest point in 1963/64. It may also be noted that in 1958/59 thirteen boats used whiting seines and drift nets, two types of gear which had been used extensively from 1954

to 1958. Following the failure, however, of vessels using these two types of gear to land appreciable catches during the 1958/59 season their use thereafter was discontinued.

BIOLOGICAL DATA.—Since 1958 Irish herring investigations have been continued each season during the November/February period. Herrings were examined for length, sex, maturity of the gonads, age (from the scales and otoliths), vertebral counts and racial types. During the 1962/63 and 1963/64 seasons fat content estimations were also made.

Diagrams showing the age distributions obtained from the Irish ring-net and trawl data are included in Fig. 3. It will be readily seen that the recruitment of 3-year-old herrings to the adult fishery was very good during three seasons (1959/60, 1960/61 and 1963/64), fair during two seasons (1961/62 and 1962/63) and a failure in one season (1958/59). An examination of all the available age distributions during the 1952 to 1964 period shows that recruitment normally takes place in the Dunmore fishery when the fish are 3-year-olds. There is, however, a small influx each season of fast growing 2-year-olds and slow growing 4-year-olds.

The maturities of the gonads recorded during the six seasons in question have been combined in histogram form—see Fig. 4. Before Christmas each season a large percentage of the fish were in maturity stage V (fulls) but a certain number were in Stage VI (running). After Christmas the majority of the fish were in Stage VI. Throughout each season small numbers of Stage VII (spents) appeared in the catches indicating a prolonged spawning period. Immature fish were also taken in the catches, in certain years, particularly when the estuarine fishing was vigorously pursued.

The most obvious feature of the maturity observations was the similar pattern of the different maturity stages present each month throughout all the season. Stages V and VI always dominated in the catches while stages IV and VII also occurred. Available evidence on the maturity stages during the main Dunmore season shows that there is no admixture of racial types. This view is further strengthened by the Otolith classification. All catches landed at Dunmore East were composed of a winter spawning community which for the purposes of fishery management and assessment may be considered as a homogeneous unit. These observations agree with the conclusions of the Dunmore Working Group viz. "that the fishery is centred principally on a spawning community which approaches the Irish coastal area at the onset of spawning and leaves after the spawning period".

TOTAL MORTALITY.—Total mortality estimations have been calculated from the seasonal age distributions of the fully recruited year classes and the total catch from the fishery. This information has been used to calculate an economic yield figure for the fishery which lies between 12,000 and 15,000 tons per season. In Table 1 the total catch

for the fishery in each of the years/seasons 1951 to 1962 is shown and it may be readily seen that there was over-fishing during the 1957/58/59 period. Following the heavy landings of 1957/58, however, recruitment of 3-year-olds to the adult fishery in 1960/61 was very good, with the result that the fishery withstood the intensive exploitation to which it had been subjected. Nevertheless the fishery could not have withstood a continued effort at the previous high level. Since January, 1960, total landings have shown an appreciable decline.

FAT ESTIMATIONS.—During the 1962/63 and 1963/64 seasons fat estimations were carried out for the Dunmore fishery. A summary of the results is given in Table 5.

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TABLE 1—Annual and seasonal landings, expressed in tons, for the 1921 to 1964 period.

Year or Season	Irish Tonnage	Year or Season	Irish Tonnage	Year or Season	Irish Tonnage	Tonnage by Foreign Vessels	Total Tonnage
1921 ..	625	1936	389	1951	499	2,524	3,023
1922 ..	718	1937	258	1952	280	3,800	4,080
1923 ..	690	1938	256	1953	362	3,413	3,775
1924 ..	1,198	1939	262	1954	845	4,093	4,938
1925 ..	1,566	1940	612	1955	1,252	6,407	7,659
1926 ..	2,797	1941	899	1956	3,026	8,555	11,581
1927 ..	2,480	1942	106	1957/58	4,700	21,406	26,106
1928 ..	994	1943	157	1958/59	8,120	14,818	22,938
1929 ..	104	1944	136	1959/60	10,415	2,863	13,278
1930 ..	309	1945	180	1960/61	11,287	1,813	13,100
1931	117	1946	519	1961/62	5,250	5,593	10,843
1932 ..	118	1947	1,293	1962/63	4,048	Incomplete	Incomplete
1933 ..	209	1948	781	1963/64	3,850	"	"
1934 ..	187	1949	401	—	—	—	—
1935 ..	228	1950	520	—	—	—	—

TABLE 2—Monthly landings, expressed in crans, for Irish boats

Month	1958/59	1959/60	1960/61	1961/62	1962/63	1963/64
October ..	—	1,033	4,485	1,272	68	452
November ..	10,202	15,806	13,506	5,340	2,910	4,834
December ..	12,074	13,487	33,150	13,950	11,998	3,406
January ..	10,890	16,363	13,305	6,560	10,394	9,936
February ..	9,944	12,744	—	1,800	—	3,384
March ..	3,000	—	—	200	—	—
TOTALS ..	46,110	59,463	64,446	29,122	25,370	22,012

TABLE 3—Comparison of monthly catch (in crans) by ring nets and by other types of gear

Month	1958/59		1959/60		1960/61		1961/62		1962/63		1963/64	
	Ring Nets	Others	Ring Nets	Others	Ring Nets	Others	Ring Nets	Others	Ring Nets	Others	Ring Nets	Others
October ..	—	—	1,033	—	4,183	302	1,238	34	68	—	452	—
November ..	8,160	2,042	13,466	2,340	11,612	1,894	3,905	1,435	1,056	1,854	812	4,022
December ..	9,656	2,418	8,096	5,391	14,567	18,583	6,426	7,524	765	11,233	175	3,231
January ..	5,040	5,850	8,534	7,829	1,724	11,581	1,682	4,878	—	10,394	65	9,871
February ..	3,086	6,258	3,622	9,152	—	—	500	1,300	—	—	—	3,384
March ..	2,700	300	—	—	—	—	—	200	—	—	—	—
TOTALS ..	28,642	17,468	34,751	24,712	32,086	32,360	13,751	15,371	1,889	23,481	1,504	20,508

TABLE 4—Number of Irish boats attending the fishery and the types of gear used per season

Type of Gear	Number of Vessels					
	1958/59	1959/60	1960/61	1961/62	1962/63	1963/64
Ring Net ..	37	40	42	21	11*	4
Vinge Trawl ..	19	53	43	19	52	29
Purse Seine ..	5	2	5	2	3	2
Whiting Seine	9	—	—	—	—	—
Larsen Trawl	—	—	6	8	5	2
Drift Net ..	4	—	—	—	—	—
TOTALS ..	74	95	96	50	71	37

* 10 of these boats used Vinge Trawls from 18/12/'62 onwards.

TABLE 5—Fat content of samples of Dunmore East herrings (as determined from moisture content)

Date of Sampling	Location	Estimated Fat Content	Date of Sampling	Location	Estimated Fat Content
		%			%
5/12/62	Waterford Harbour ..	10.6	8/11/63	Dunmore East ..	16.1
5/12/62	Waterford Harbour ..	9.2	15/11/63	Baginbun Bay	16.6
6/12/62	Tramore Bay ..	11.6	20/11/63	Dunmore East	14.0
6/12/62	Tramore Bay	12.4	21/11/63	Hook to Tramore	15.3
10/12/62	S.W. of the Hook ..	13.9	27/11/63	4 miles S.W. of the Hook ..	14.8
11/12/62	S.W. of the Hook ..	12.4	27/11/63	4 miles S.W. of the Hook ..	12.4
12/12/62	W. of Tramore ..	11.5	8/12/63	Dunmore East	13.2
14/12/62	S.W. of the Hook ..	11.5	9/12/63	Brownstown Head	18.9
18/12/62	Baginbun Bay ..	10.6	10/12/63	Brownstown Head	15.6
18/12/62	Tramore Bay	10.7	16/12/63	Brownstown Head	17.7
19/12/62	Baginbun Bay	10.2	6/1/64	Tramore Bay	11.0
20/12/62	Bagunbun Bay ..	10.1	7/1/64	Tramore Bay	10.0
21/12/62	Baginbun Bay	8.6	9/1/64	Dunmore East	11.8
3/1/63	Baginbun Bay ..	7.7	14/1/64	Tramore Bay	12.1
17/1/63	Tramore Bay	5.2	21/1/64	Baginbun Bay	10.9
30/1/63	S.W. of the Hook ..	2.7	23/1/64	Baginbun Bay	10.4
			30/1/64	Baginbun Bay	11.5
			4/2/64	Baginbun Bay	7.3

The estimated fat content was calculated (see Otto Wille, Der Fisch, Band III, *Handbuch der Fischkenservierung*. Lubeck, 1949, p. 692) from the following formula :

$$\text{Fat content (\%)} = 100 - (\text{moisture content (\%)} + 20)$$
$$= 80 - (\text{moisture content (\%)})$$

All samples taken up to and including the 27/11/63 consisted of whole fish ; from the 8/12/63 onwards they comprised fillets.

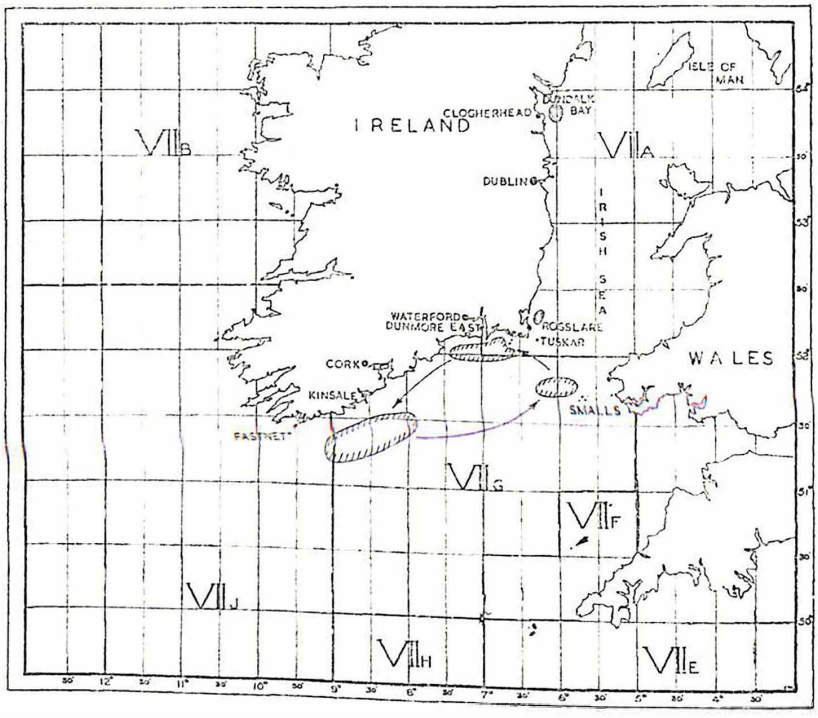
ISLE OF MAN
CLOGHERHEAD
DUNDALK BAY
IRELAND
VIIB
VIIA
DUBLIN
IRISH SEA
WATERFORD
DUNMORE EAST
ROSSLARE
TUSKAR
WALES
CORK
KINSALE
SMALLS
FASTNET
VIIG
VIIF
VIIJ
VIIH
VIIE

Fig. 1

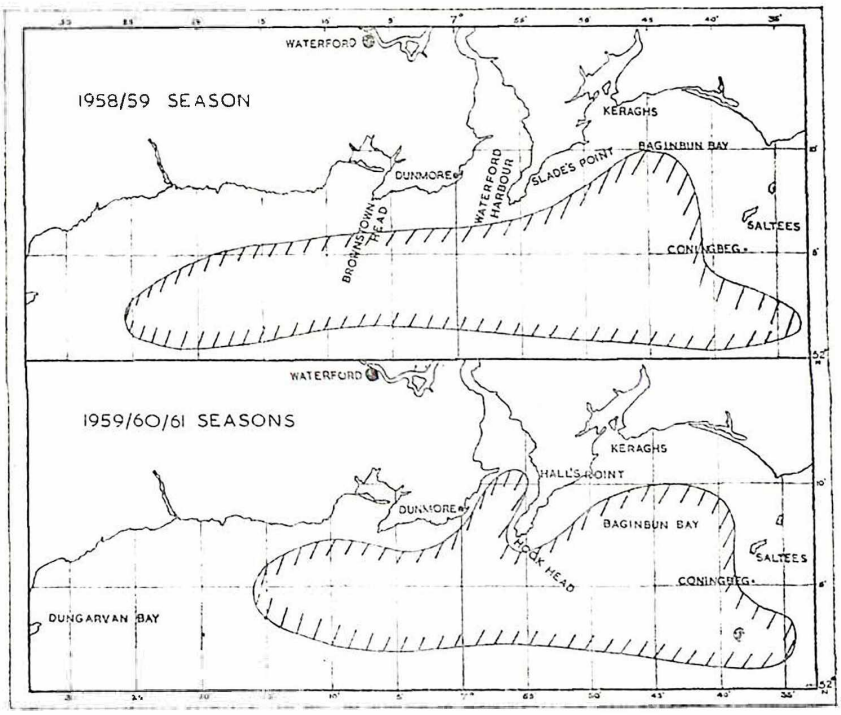
1958/59 SEASON
WATERFORD
KERAGHS
BAGINBUN BAY
DUNMORE
WATERFORD HARBOUR
SLADE'S POINT
BROWNSTOWN HEAD
SALTEES
CONINGBEG
1959/60/61 SEASONS
WATERFORD
KERAGHS
HALL'S POINT
DUNMORE
BAGINBUN BAY
HOOK HEAD
SALTEES
CONINGBEG
DUNGARVAN BAY

Fig. 2

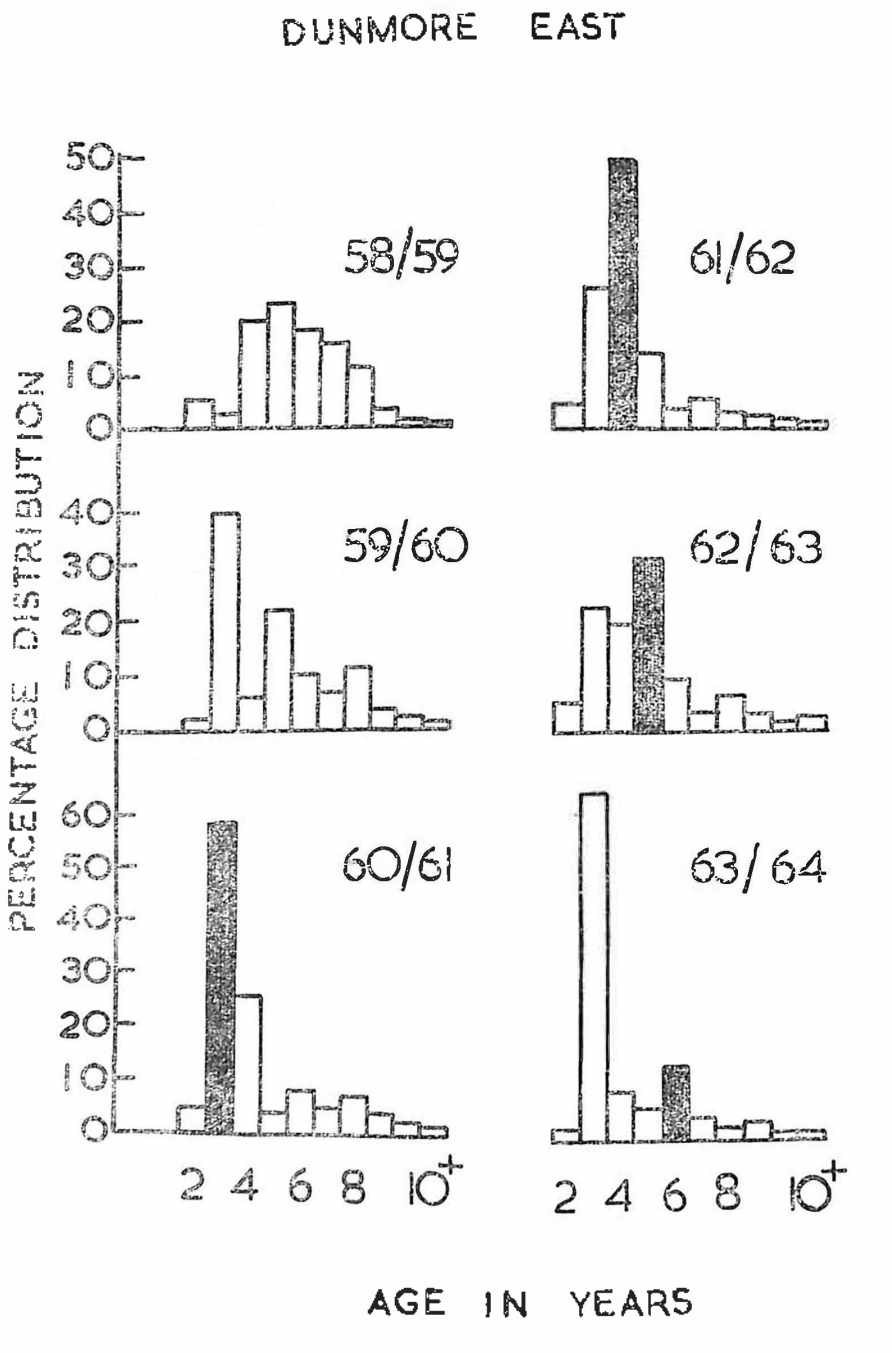
DUNMORE EAST
PERCENTAGE DISTRIBUTION
58/59
61/62
59/60
62/63
60/61
63/64
0
10
20
30
40
50
60
2 4 6 8 10+
AGE IN YEARS

Fig. 3

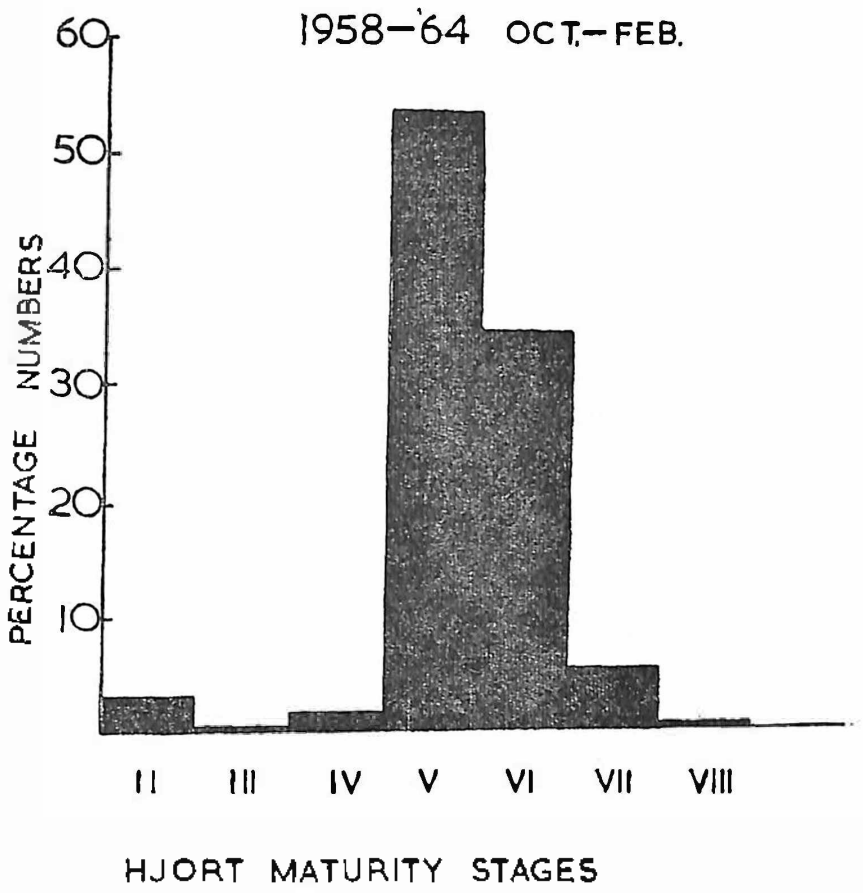
1958–'64 OCT.–FEB.
PERCENTAGE NUMBERS
60
50
40
30
20
10
II
III
IV
V
VI
VII
VIII
HJORT MATURITY STAGES

Fig. 4

APPENDIX No. 26

DONEGAL HERRING INVESTIGATIONS 1963/64

by

JOHN BRACKEN, PH.D., Assistant Inspector

INTRODUCTION.—The successful results of the Donegal herring fisheries from 1900 to 1930 depended to a large extent on the visits of Scottish steam and motor drifters which landed their catches into Killybegs, Burtonport, Buncrana and Downings. The most prosperous period was between 1908 and 1914. Over 300 steam drifters were based at Buncrana annually and the catch in 1911 reached the record figure of 312,000 cwt. Fishing was still flourishing in 1914 with landings amounting to 133,000 cwt., but on the outbreak of World War I fishing was suspended and was not renewed to any degree until 1925.

Farran (1946) sub-divided the Donegal herring fisheries into three areas viz. Donegal Bay, West Donegal and North Donegal. The total catch in each area from 1921 to 1941 was 179,760 cwt., 271,250 cwt., and 580,920 cwt. respectively. In Table I are shown the annual landings for the 1921/41 period. During the years 1927, 1928 and 1929 herring landings were again very high and accounted for 45%, 29% and 54% respectively, of the total landings in each area for the twenty year period. From 1930 onwards a steady decline occurred and annual fluctuations, at a low level, are shown in Table 1.

Scientific investigations into the Donegal herring fisheries commenced in 1921 (Farran, 1946). Samples of herrings were examined from the three main fishing grounds and the following facts emerged. In each region herring fishing fell into three well-marked phases, viz., January/February, May/July and September/October. Results of the investigations showed that two races of herrings appeared in the annual landings in each region. The major component was a winter/spring spawning group which was actually fished twice each year. In the January/February period these fish were taken, mainly as large fulls which approached the inshore waters with the onset of spawning. These herrings were again fished in May/July as recovering spents. The second race of herrings was an autumn-spawning one and was relatively unimportant in the overall landings. The mean length and age for each separate component in all three areas corresponded closely and were considered by Farran to be identical.

The location and extent of each fishery was also recorded annually and a uniform pattern emerged. In Donegal Bay and adjacent areas fishing commenced along the north Mayo coast and moved northwards to Rathlin O'Birne Island for spring-spawning herrings which in May and June were coming into condition after spawning. Visiting foreign boats also took part in an inshore fishery in September/October for autumn-spawning herring. On the west coast of Donegal

the same types of herrings were landed at roughly the same times. The herrings in this area moved in a northerly direction towards Tory Island. There was also an inshore ring-net fishery for autumn spawners carried on by local boats and Scottish ring-netters from Campbelltown. The herring fishery which took place every spring and early summer off the north coast of Donegal was the most regular and uniform on the Irish coast. The potential of this fishery was not realised until 1908 although efforts to assess its value had been made as early as 1902. It is of interest to record here that the life-history of these herrings was fully worked out by Storrow (1930), Le Gall (1930) and Farran (1946). Samples taken during the May/July fishing, ten to twenty miles north-east of Lough Swilly, closely resembled the herrings taken by French steam trawlers working on the edge of the deep water forty to fifty miles north-north-west of the Donegal coast (Le Gall, 1930). The disappearance of the fish from the inshore fishery off the Donegal coast corresponded with the commencement of the trawl fishery in the area known as the "Klondyke" grounds. According to Le Gall, the herrings remained on the trawling grounds in 60 to 80 fathoms from July to October. Then as their gonads ripened an inshore movement again took place. A small autumn fishery, similar to the Donegal Bay and west Donegal fisheries, was also exploited.

Farran (1946), summarising all the available data, showed that several important differences existed between the autumn and winter/spring components. The initial racial separation was based entirely on the maturity stages of the gonads. This separation was, however, valid and enabled Farran to show that the age composition, recruitment and stock abundance varied for each component. In Fig. 1 the percentage age distributions for the North Donegal winter/spring component is summarised for the 1921/36 period. These distributions were selected from the rest of the data because they show clearly that great variations in recruit brood strength occurred from year to year. The 1920, 1924 and 1925 year broods were outstanding and were to a large extent the mainstay of the fishery. From 1929 to 1936 recruitment failed with monotonous regularity—a fact borne out by the dwindling catches from that time onwards. While the 1931 year class appears at first sight to have been a strong recruit brood, it is so only in comparison with the preceding succession of poor year classes. Farran maintained that the rapid decline of the landings was due to the scarcity of the winter/spring component.

The Second World War was responsible for the suspension of herring fishing for the second time since 1900 and on resumption no landings of consequence were made before 1955. Table 2 shows the annual landings since 1942. Killybegs and Burtonport are now the two main ports and herrings are landed there exclusively by Irish based boats. Scientific investigations were initiated in May, 1962, at Killybegs and were extended to cover Burtonport and Rosbeg during the 1963/64 season.

1962 HERRING INVESTIGATIONS.—Samples of herrings landed at Killybegs during the May/October period, 1962, were examined for length, sex, maturity, age and racial type. As the quantities landed prior to November were small and as the main season commenced after these preliminary investigations had been concluded, the results obtained may not have been truly representative of the existing stocks in Donegal Bay. Two distinct races of herrings were identified, the majority of the fish (77%) being autumn-spawners and the remainder (23%) a mixture of winter and spring spawning types. No attempt was made to separate the winter and spring spawning types. A summary of the monthly age distributions for the autumn component is shown in Table 3.

The dominant year classes in the autumn spawning group were the 5- and 4-year-olds, while the 8- and 6-year-olds were also well represented. Similar dominant year classes were found in the winter/spring group but the 3- and 7-year-olds were also prominent.

The racial type of the herrings was determined by examination of the otoliths and confirmed by other meristic characters such as the numbers of vertebrae and the maturity of the gonads. The maturity stages per year class per racial type are shown in Table 4.

All stages of maturity were found. Monthly totals per year class per maturity stage (not included in this paper) show that the autumn-spawners were mainly recovering spents (Stage VIII) and maturing virgins (Stages II and III) in May, 1962. Development continued gradually during June and July when the majority of the fish were becoming full (Stage V). In August and September the autumn spawners were in advanced Stage V (full) with some in Stage VI (running). By the end of October, the major portion of these fish had spawned (Stage VII). The winter/spring spawners showed a much slower rate of development. In October, Stage V (full) was dominant for winter/spring types and Stage VII (spents) for the autumn spawners. The major portion of the landings from Donegal Bay took place after these investigations ended in October, 1962 but, from information collected from skippers attending the main fishery, it would appear that the autumn component (present as *spents* in the catches) made up approximately 80% of the total landings.

SPRING SPAWNING ADULTS IN DONEGAL BAY.—A sample of large herrings, in an advanced stage of maturity (Stage VI), taken north of the Stags of Broadhaven on 22 March, 1963, was also examined. The length groups recorded covered a wide range from 28.5 to 39.5 cm. with a peak at 36.0 cm. The age distribution is shown in Table 5. In Table 6 the numbers of fish, mean length, mean vertebral count per maturity stage per year-class are summarised.

Over 90% of these herrings were in a spawning condition (Stage VI). The otoliths were typical of spring spawners. There is, however,

no known commercial spring-spawning fishery in the area where these fish were taken.

1963 HERRING INVESTIGATIONS.—The sampling programme carried out during the 1963/64 season was much more extensive and covered all the monthly catches from May, 1963, to January, 1964. The main fishing season commenced on 1 November, 1963, and ended on 14 January, 1964. Sporadic landings were recorded after this date. In Fig. 2 a comparison between the May/October percentage age distributions for 1962 and 1963 is shown. This period was not considered to give a truly representative picture of the existing stocks in the area during 1962 as the herrings landed were taken only as a by-catch. There is, nevertheless, a similar age distribution found for this period over the past two years. These herrings were mainly autumn spawning types.

In Fig. 3 the percentage age distribution for the 1963/64 season per racial type shows that from November onwards there was a big influx of winter spawners into the Killybegs landings. According to the local skippers, this was completely abnormal as in preceding years spents made up 80% of the total landings throughout the season indicating that the fishery was predominantly for autumn spawning herrings. In an effort to explain the presence of large numbers of winter spawners in the catches at Killybegs during 1963/64, the location and extent of all herring fisheries in close proximity were studied. In November, 1963, samples were obtained from Burtonport, Rosbeg and Killybegs. In each area both autumn and winter spawners were taken in the same catches. The age distributions for each area were also similar as will be seen from Fig. 4 which shows the percentage age distributions for each port. The Burtonport herring fishery was, in the opinion of the local fishermen, a failure in 1963/64 ; available evidence indicates, however, that the herring shoals which are normally located north of Arranmore Island, close to Burtonport, were much further south in the 1963/64 season. Fishing commenced north of Arranmore and moved slowly southwards to Teelin Harbour. The shoals then turned towards the outside of Rathlin O'Birne Light, entered the sound and eventually left the inshore waters in a north-westerly direction. They were pursued for a distance of 18 miles.

Eighteen boats, using mid-water trawls, attended the fishery and landed their catches at Killybegs. Isolated ring-net landings were made by several boats during the season.

Initially the maturity stages of the gonads were used to separate the autumn and winter/spring spawners. In Table 7 are given the maturity stages per year class, the numbers of fish, the mean length and the mean vertebral count. As will be seen from the table 47.5% were winter spawners and 52.5% were autumn spawners. The autumn spawners were all in Stages VII and VIII (spents and recovering spents), while the winter/spring group were all fulls (Stage V)

or filling (Stages III-IV, IV and IV-V). The mean length of the winter/spring race was greater per age class than in the autumn spawners. The mean vertebral count of the autumn spawners (56.51) was lower than that for the winter/spring group (56.90).

Einarsson (1951) showed that it was possible in a mixed fishery to separate winter/spring and summer/autumn spawned fish by an examination of the otoliths. Since the majority of herrings landed at Killybegs were trawl-caught fish and lacked scales, the otoliths were used to age the fish and, by means of an examination of their nucleus (central portion) and first winter ring, to determine the race to which each individual fish belonged. Only the data collected during the main fishing season were used. A total of 1,888 herrings examined during the November/January period were first divided into maturity stages per age class and then classified, according to first winter ring of the fish, into racial types. However, this classification was unnecessary with these Killybegs herrings as the maturity stages were sufficient to separate the two components. The first winter ring of each fish was examined and placed into one of three categories, viz., narrow first winter ring (N), wide first winter ring (W) and unclassified first winter ring (U), the last group including broken and decalcified otoliths which were unusable. The distribution of each otolith type for the 1,888 fish examined was as follows:—

	N	W	U	Nos. Examined
Autumn Type ...	61%	36%	3%	890
Winter Type ...	15%	77%	8%	998

A striking difference between the first winter ring types is clearly shown for each race. The "narrows" completely dominated in the autumn spawners while the "wides" dominated in the winter/spring spawners. The dominant year classes in each race were extracted and showed the following percentage distributions:—

Age	Year Class	Autumn				Winter			
		N	W	U	Nos. Examined	N	W	U	No. Examined
	1958	61	37	2	190	14	76	10	375
	1957	70	28	2	134	19	64	17	95
	1956	—	—	—	—	15	81	4	95
	1955	53	45	2	152	16	79	5	141
	1954	—	—	—	—	8	86	6	159

These figures again emphasise the difference between the two races. The "narrows" in the three dominant year classes of the autumn group dominated, as did the "wides" in the winter/spring race.

As already stated, samples of herrings from three different ports, Killybegs, Rosbeg and Burtonport were examined during November and the age distribution per racial type are compared in Fig. 4. To supplement this information, a comparative analysis of the otolith types for each area was carried out. The results are shown below:—

Port	Race	N	W	U	No. Examined	Mean Vert Count
Killybegs	Autumn	62	35	3	63	56.65
	Winter	12	81	7	85	56.95
Rosbeg	Autumn	63	32	4	434	56.54
	Winter	14	78	8	131	56.99
Burtonport	Autumn	65	32	3	68	56.50
	Winter	10	82	8	222	56.90

Two important facts may be noted from this table;

(1) The classification, expressed as a percentage distribution, is constant regardless of where the fish were taken. It may, therefore, be concluded that all the landings came from the same two races of herrings, and

(2) The percentage of autumn and winter/spring types in a given catch depended to a large extent, on where the boats fished.

IMMATURE AND RECRUIT BROOD HERRINGS IN DONEGAL BAY.—Two samples of immature herrings were examined from Donegal Bay in July and August 1962. Both samples were taken by trawl close to the shore off St. John's Point. The age distributions of these two samples as calculated from the otoliths have been combined in Table 8. It had first been thought that 2-year-old herrings could be separated into two groups by an otolith classification. Out of a total of 619 fish 416 had been classed as early autumn spawners (mean vertebral count 56.48) and the other 203 fish as winter spawners (mean vertebral count 56.77). All these fish have, however, now been combined into one group, a late autumn spawning component with an overall mean vertebral count of 56.57.

Further samples of these small herrings were obtained during the period July/October 1963. In July four samples were examined and only immature herrings were found. No samples were taken in August but in September and October some of the samples of small herring contained full fish which would have spawned that year (Table 8). Altogether, 909 1-winter ring and 281 2-winter ring fish were examined. Of these totals, 55 1-winter ring and 202 2-winter ring fish were recruit spawners but at the time of capture had not yet joined the adult stocks. A small percentage of the 2-year-old fish may, therefore, recruit to the adult stocks each year. The number

of year classes in which recruitment occurs is not yet known for this area. The otolith classification of the 1-winter ring herrings shows that the percentage distribution of the "narrow" and "wide" first winter ring is similar to that obtained in the adults:—

	N	W	U	Totals	Mean Vert. Count
1962 ..	80%	14%	6%	622	56.57
1963 ..	87%	7%	6%	836	56.42

SUMMARY

1. The history of the Donegal herring fisheries and associated areas has been reviewed for the 1900 to 1941 period. During this period the presence of two races of herrings was known, viz., a winter/spring spawning component and an autumn spawning one. The winter/spring component was the more important of the two in Donegal Bay, West Donegal and North Donegal. This component was fished twice each year during January/February and again in May/July. The autumn component was relatively unimportant and was only fished in shallow water, close to the shore during September/October.

2. Herring samples, numbering 2,829 fish in 1962 and 7,303 fish in 1963/64, were examined for length, sex, maturity, age, vertebral count and racial type. Although the present investigations have only been carried out for one full season (1963/64) and part of another (May/October 1962) several important facts have emerged. Autumn and winter-spring components have again been identified but in the case of Donegal Bay the autumn spawning group is now the more important. Fishing in West Donegal is still confined to a winter/spring component which, in the 1963/64 season, moved much further south than usual. No reference has been made in the earlier literature to the admixture of stocks such as occurred in the area north of Donegal Bay during the 1963/64 season.

3. The present separation into autumn and winter/spring components in Donegal Bay is based primarily on the maturity stage differences found in the November/January samples. This separation was confirmed by the otolith classification used.

4. The March, 1963, sample belonged to a spring spawning group which is not fished commercially at the moment.

5. The small herrings examined from Donegal Bay contained, during 1963, a small percentage of 1- winter ring fish and a high percentage of potential autumn spawners.

FAT CONTENT OF SAMPLES OF DONEGAL HERRINGS

Samples of herrings were examined for fat analyses and the following results obtained:—

Date of Sampling	Location	Moisture Content (%)		Estimated Fat Content (%)	
		Full Fish	Spent Fish	Full Fish	Spent Fish
4/12/63	Donegal Bay between Rathlin O'Birne and Carrigan Head ..	59.56	71.80	20.44	8.20
9/12/63	Off Carrigan Head	63.46	67.50	16.54	12.50
17/12/63	Off Malinbeg, close to Rathlin O'Birne Light	65.32	71.36	14.68	8.64
7/1/64	1 mile East of Rathlin O'Birne ..	67.80	71.76	12.20	8.24
15/1/64	3 miles off Glen Head ..	68.30	71.14	11.70	8.86

All estimations were obtained from fillets.

The estimated fat content was calculated from the following formula*:—

$$\text{Fat Content } (\%) = 100 - (\text{Moisture Content } (\%) + 20)$$
$$= 80 - \text{Moisture Content } (\%)$$

*Otto Wille, Der Fisch, Band III, *Handbuch der Fischken servierung*, Lubeck, 1949, p. 692.

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TABLE 1—Annual Landings of Herrings, in hundredweights, for the period 1921 to 1941.

	Donegal Bay	West Donegal	North Donegal
1921	2,766	8,024	27,731
1922	3,428	9,981	7,589
1923	2,812	5,185	5,666
1924	5,429	12,600	9,822
1925	394	7,164	48,781
1926	3,353	8,950	54,803
1927	4,894	24,817	122,808
1928	53,305	39,015	114,435
1929	23,398	13,945	73,957
1930	12,072	15,637	29,346
1931	8,207	13,888	10,332
1932	880	12,068	2,156
1933	4,765	2,572	9,377
1934	2,679	31	3,545
1935	5,711	5,982	10,696
1936	8,711	10,433	13,555
1937	3,404	9,918	19,814
1938	11,375	12,400	8,098
1939	5,187	18,218	2,726
1940	7,864	26,067	2,395
1941	9,128	14,355	2,456

TABLE 2—Seasonal Landings of Herrings, in crans, for the 1942-'63 period

	Donegal Bay	West Donegal	North Donegal
1942	1,055	1,432	1,393
1943	1,759	2,988	576
1944	732	1,666	332
1945	357	8,991	3,491
1946	205	3,920	2,412
1947	2,512	8,087	3,880
1948	551	3,062	1,350
1949	751	3,314	693
1950	1,546	5,381	381
1951	2,623	4,198	84
1952	1,163	2,100	88
1953	957	6,584	260
1954	887	6,844	114
1955	6,300	8,109	391
1956	10,030	7,386	284
1957	15,430	14,310	206
1958	4,588	17,460	1,038
1959	9,572	12,377	2,936
1960	7,731	13,879	237
1961	19,626	11,895	—
1962	16,129	6,345	109
1963	13,916	6,450	—

TABLE 3—Monthly age distributions for Autumn spawners. (1962)

No. of Winter Rings	2	3	4	5	6	7	8	9	10	11	12
May ..	8	23	14	1	—	2	—	—	—	—	—
June ..	1	21	41	15	3	9	1	1	—	1	—
July ..	12	43	167	50	36	61	41	36	7	5	2
August ..	14	73	134	31	9	24	16	10	3	1	—
September ..	5	12	5	—	1	1	—	—	—	—	—
October ..	35	142	223	71	77	91	49	32	18	2	1
TOTALS ..	75	314	584	168	126	188	107	79	28	9	3

TABLE 4—Maturity Stages/Year Class/Racial Type

Age in Years ..	2		3		4		5		6		7		8		9		10		11		12		13		Totals	
Maturity *	A	W/S	A	W/S	A	W/S	A	W/S	A	W/S	A	W/S	A	W/S	A	W/S	A	W/S	A	W/S	A	W/S	A	W/S	A	W/S
II (Maturing) ..	–	1	28	53	67	26	37	19	3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	135	99
III (Maturing) ..	–	–	11	9	55	24	125	45	37	5	36	8	51	12	21	6	16	7	9	3	3	1	–	–	364	120
IV (Filling) ..	–	–	27	11	96	23	175	33	53	10	21	2	38	9	22	4	24	4	11	3	4	–	–	2	471	101
V (Full) ..	–	–	16	22	83	37	130	34	31	12	13	19	45	–	40	3	20	1	10	2	1	–	–	–	389	130
VI (Running) ..	–	–	2	–	33	–	19	26	5	6	10	20	11	21	5	1	5	–	2	–	–	–	–	–	92	74
VII (Spent) ..	–	–	13	–	94	–	160	1	49	–	42	4	46	1	44	4	26	3	15	4	3	–	1	–	493	17
VIII (Recovering Spent)	–	–	2	–	23	11	89	33	37	9	35	19	53	18	22	16	34	5	24	10	5	1	1	1	325	123
TOTALS ..	–	1	99	95	451	121	735	191	215	42	157	72	244	61	154	34	125	20	71	22	16	2	2	3	2,269	664

* A—*Autumn* Spawning Type. W/S—Winter/Spring Spawning Type.

TABLE 5—Age distribution of Spring spawners—March 1963

No. of Winter Rings ..	4	5	6	7	8	9	10	11	12	13	14	15	Total
Nos. of Fish ..	5	4	6	9	10	18	31	21	10	3	4	1	122

TABLE 6—Numbers of fish, mean length, mean vertebral count per maturity stage per year class

Number of Winter Rings	4	5	6	7	8	9	10	11	12	13	14	15
Maturity												
V (Full) ..	1	—	—	1	—	—	3	1	—	—	—	—
	35.00	—	—	34.60	—	—	36.30	35.00	—	—	—	—
	57.00	—	—	57.00	—	—	57.00	56.00	—	—	—	—
VI (Running) ..	4	4	6	7	8	18	27	20	10	3	4	1
	29.70	34.30	33.43	33.27	35.69	36.52	36.32	36.93	37.26	37.37	38.05	38.6
	56.75	57.25	57.17	57.00	56.62	57.22	56.92	56.95	56.90	57.67	57.00	57.00
VII (Spent) ..	—	—	—	1	2	—	1	—	—	—	—	—
	—	—	—	31.20	31.80	—	34.50	—	—	—	—	—
	—	—	—	58.00	57.00	—	57.00	—	—	—	—	—
TOTAL	5	4	6	9	10	18	31	21	10	3	4	1

TABLE 7—Comparative Maturity Stages for the Autumn and Winter components during December, 1963

AUTUMN COMPONENT

Maturity Stages	1	2	3	4	5	6	7	8	9	10	11	12	Nos. of fish Examined
VII (Spents)	— — —	24 26.23 56.62	26 28.00 56.50	24 29.19 56.58	94 29.64 56.56	48 30.05 56.44	26 30.66 56.42	68 30.90 56.56	54 31.10 56.50	23 31.35 56.35	30 31.20 56.47	6 31.18 56.00	423
VIII (Recovering Spents)	— — —	16 26.37 56.75	7 27.96 56.57	5 29.06 57.20	14 29.51 56.36	15 29.94 56.40	5 29.96 56.60	18 30.73 56.28	9 30.78 56.67	4 31.17 56.50	2 31.65 56.50	1 31.00 56.00	96
Totals and Means	— — —	40 26.28 56.67	33 27.99 56.51	29 29.16 56.69	108 29.63 56.54	63 30.02 56.43	31 30.55 56.45	86 30.87 56.50	63 31.05 56.52	27 31.32 56.37	32 21.23 56.47	7 31.16 56.00	519

WINTER COMPONENT

II (Immatures)	1 25.6 57.00	2 25.20 57.50											3
III–IV (Filling)									1 32.20 57.00				1
IV (Filling)			1 30.30 58.00		2 31.05 57.00					1 32.50 57.00			4
IV–V (Filling)			2 29.25 57.00	4 30.55 56.75	21 30.52 56.90	2 31.05 56.50	3 32.00 56.67	2 32.55 56.50	4 32.55 57.25	2 32.70 57.50	2 33.60 57.50		42
V (Full)		2 26.80 57.00	12 29.11 56.75	9 30.42 56.78	176 30.81 56.83	41 31.22 56.83	33 31.88 57.27	60 32.45 56.97	52 32.24 56.86	27 32.71 56.96	8 33.22 56.87		420
Totals and Means	1 25.60 57.00	4 26.00 57.25	15 29.21 56.87	13 30.46 56.77	199 30.78 56.84	43 31.21 56.81	36 31.89 57.22	62 32.16 56.95	57 32.26 56.89	30 32.70 57.00	10 33.30 57.00		470

TABLE 8—Age distribution and maturity stages of Donegal Bay immature and recruit brood herrings

No. of Winter Rings	0	1	2	Out	Total
July/Aug. 1962					
II (Immature) ..	3	619	21	57	700
July/Oct. 1963					
II (Immature) ..	0	854	79	0	933
III (Immature) ..	0	0	6	0	6
IV (filling) ..	0	24	5	0	29
V (full) ..	0	26	131	0	157
VI (running) ..	0	1	6	0	7
VII (spent) ..	0	4	54	0	58

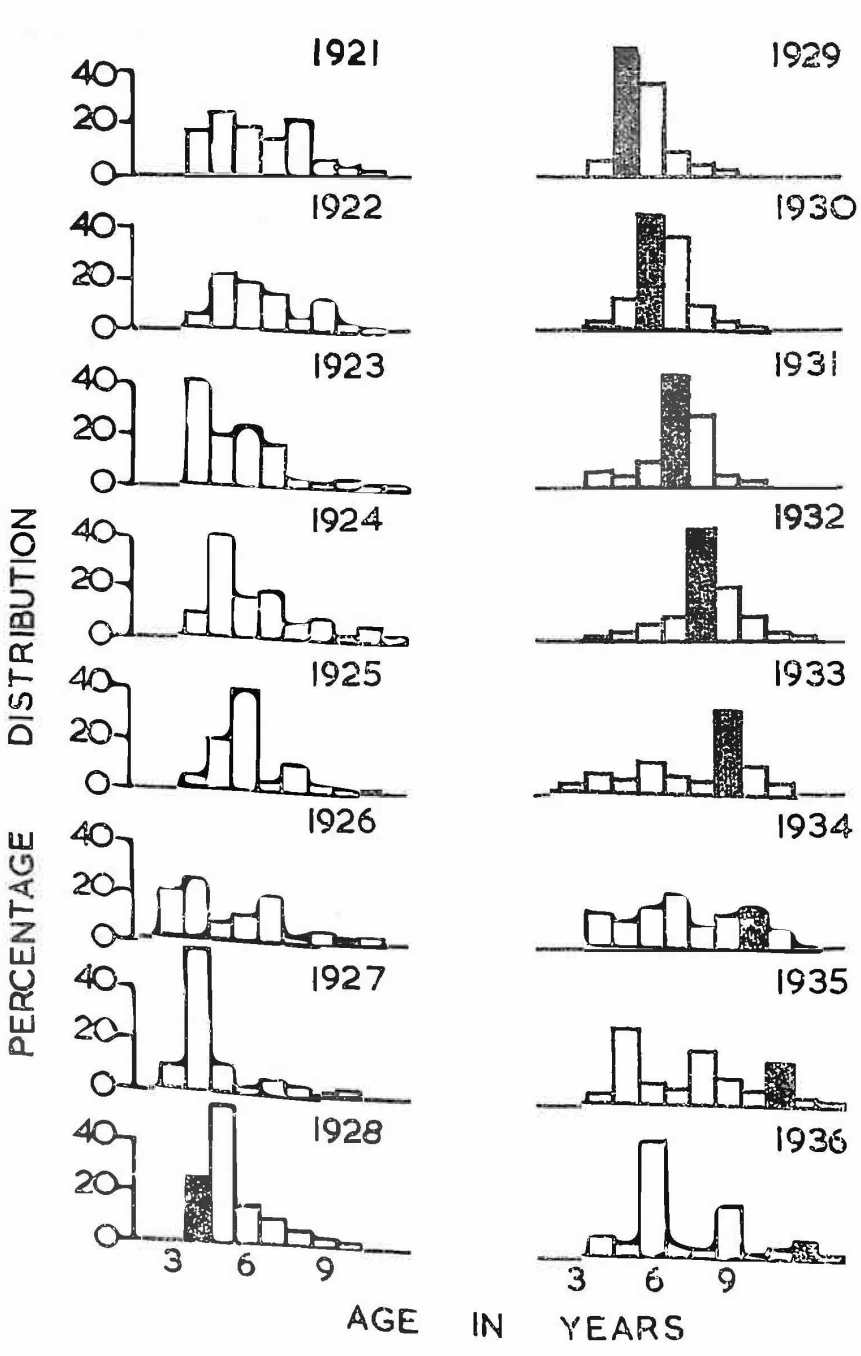

1921
1922
1923
1924
1925
1926
1927
1928
1929
1930
1931
1932
1933
1934
1935
1936
40
20
0
3
6
9
PERCENTAGE DISTRIBUTION
AGE IN YEARS

Fig. 1

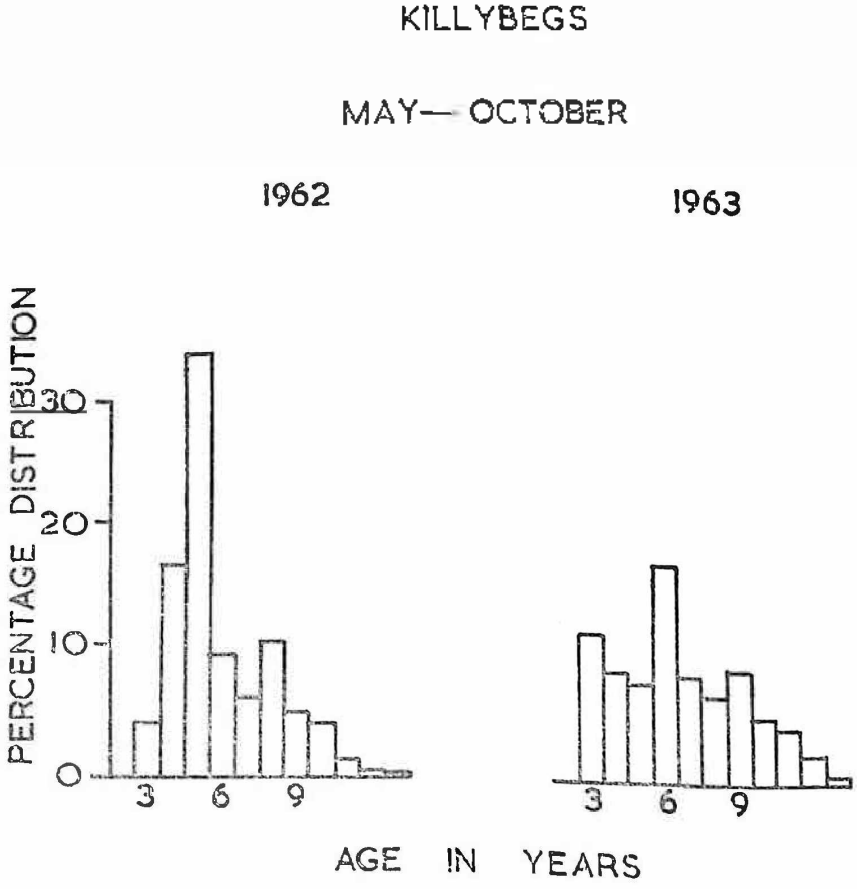

KILLYBEGS
MAY— OCTOBER
1962
1963
PERCENTAGE DISTRIBUTION
30
20
10
0
3
6
9
3
6
9
AGE IN YEARS

Fig. 2

KILLYBEGS

NOVEMBER—JANUARY 1963/64

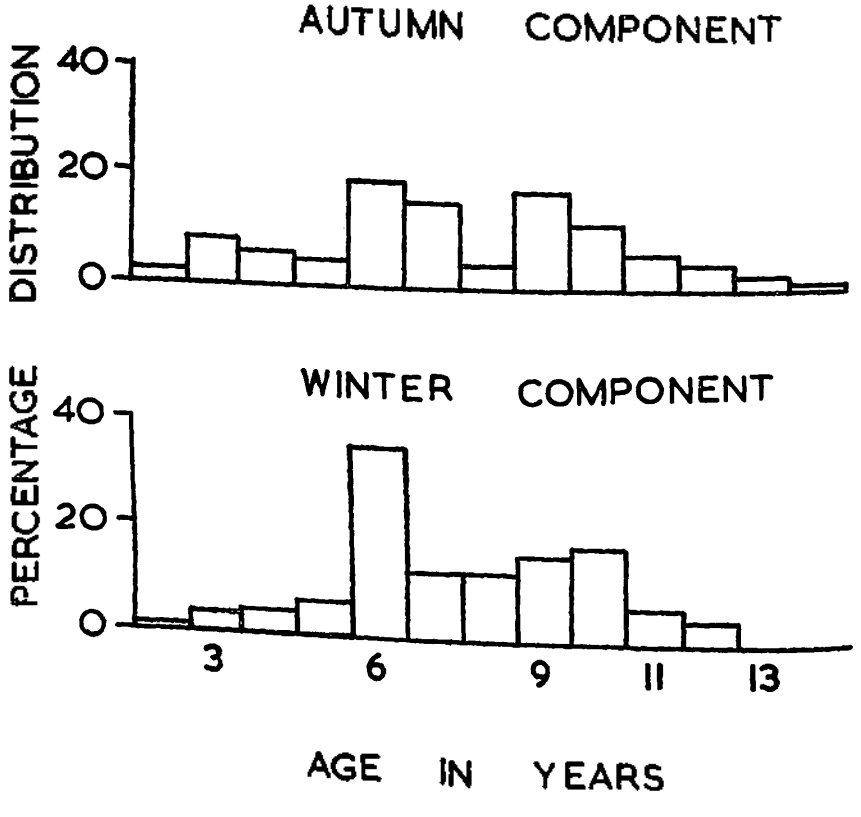
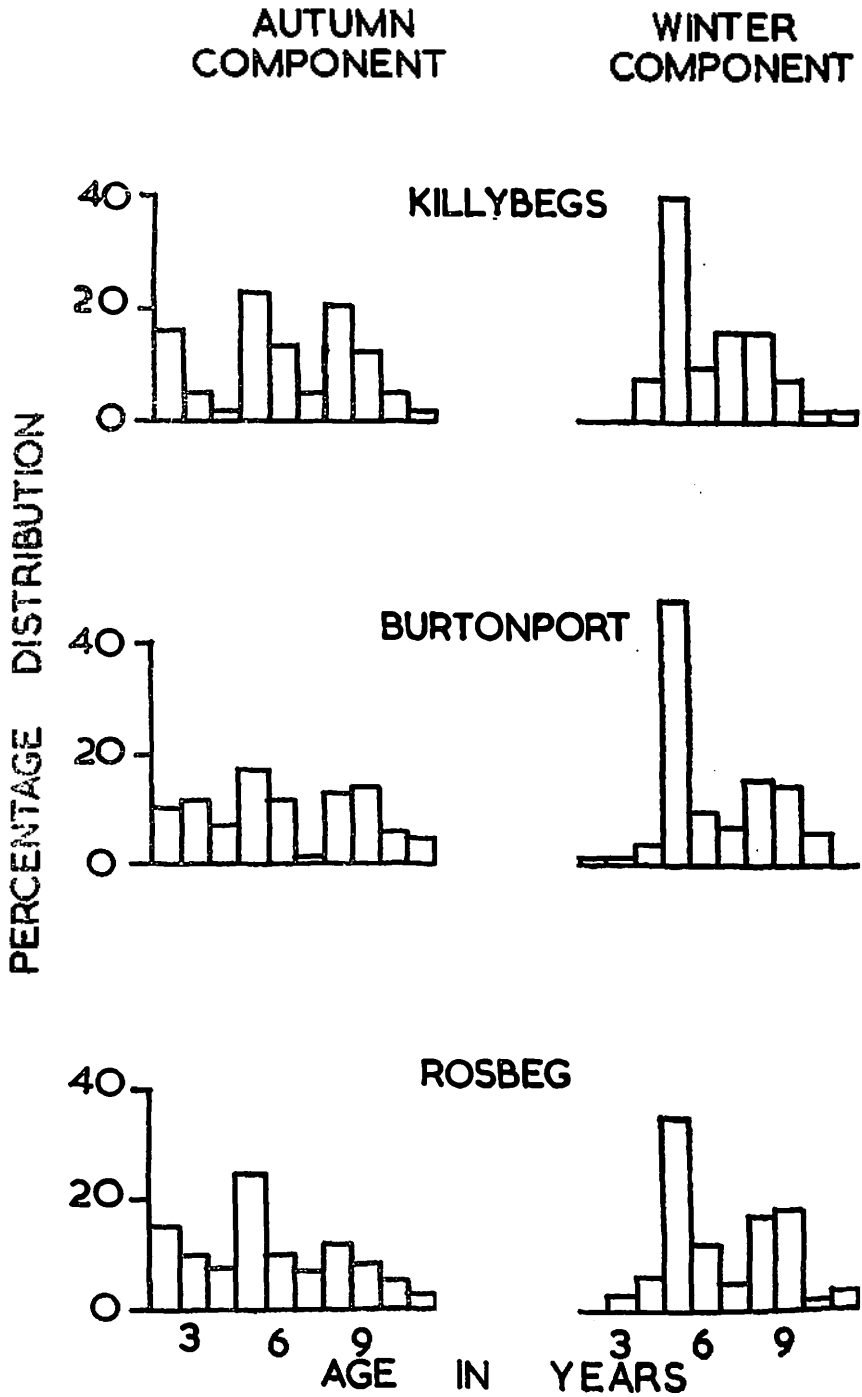


Fig. 3



NOVEMBER 1963

Fig. 4

APPENDIX No. 27

RACIAL ANALYSES OF DUNMORE EAST HERRING STOCKS BY MEANS OF THE OTOLITHS

by

M. FOSTER, Senior Laboratory Assistant

Einarsson (1951) has shown that it is possible to separate in a mixed fishery the winter/spring spawned fish from summer/autumn spawned fish on the basis of the appearance of the nuclei of the otoliths. In general, the winter/spring spawned fish have small hyaline and opaque nuclei, whereas the summer/autumn spawned fish have large hyaline nuclei.

Otoliths from herrings taken at Dunmore East in the period 1960 to 1964 were examined and classified using Einarsson's method. During this period 8,653 otoliths were collected and permanently mounted in autoplax resin. They were then examined under a binocular microscope and typed. Scales were also taken from 1,621 fish and the L_1 (first year length) was calculated for each fish. The number of vertebrae was also counted for each fish. L_1 data were not available for the 1963/64 season.

The type of nucleus varied from large hyaline to opaque. Otoliths with small normal hyaline nuclei formed the major part of the samples but small quantities of otoliths with large hyaline and opaque nuclei were also present. Table 1 shows the percentage distribution of otoliths with hyaline and opaque nuclei respectively, together with the mean vertebral counts per season. It may be seen that the hyaline nuclei were present in proportions ranging from 91% to 97% of all otoliths examined each season in this area. In each case the mean vertebral counts reached the known values for winter/spring spawners in this area.

The percentage distribution of each nuclear type and the mean vertebral counts are given in Table 2. As can be seen the narrow type first winter zone dominated the hyaline type of nucleus. The mean vertebral count was high and corresponded with the known values for winter/spring spawners of this area.

The L_1 values for the wide and narrow first winter zone, irrespective of nuclear types, were calculated from the scales and the results are given in Fig. 1. The mean vertebral counts for each otolith type were as follows:—Narrow first winter zone 1960/61, 56.81, 1961/62, 56.86 and 1962/63, 56.83. For the wide first winter zone the figures were 1960/61, 56.79, 1961/62, 56.83 and 1962/63, 56.89. It can be seen that the mean vertebral count for each year, per first winter zone, was high. At no time was the known summer/autumn vertebral count (56.2-56.4) ever approached.

The L_1 data also show that the narrow type first winter zone had higher L_1 values than the wide. Since the "Narrows" would be regarded as fast growing recruits this would be expected. The "Wides" had a much slower or normal rate of growth. The overall mean L_1 for the "Narrows" was 13.24 cms. and for the "Wides" 11.06 cms. The mean L_1 values per year class, for the 1960/63 period, are given in Table 3. In Table 4 can be seen a composite picture for the three years.

Taking the 1-winter ring fish (2 years old) it can be seen that the "Narrows" have a very high L_1 value. The "Wides", in all cases, have a smaller first winter zone.

Prior to the main herring season in Dunmore East, 3 samples were examined in October 1960 and October 1961. A total of 207 fish was examined. After a routine biological examination had been carried out, it was ascertained that two distinct races were present in these samples. The summer/autumn spawners were in maturity stages VI and VII (spawning and spent fish) while the winter/spring spawners were in maturity stages II, IV and V (immatures, filling and full fish). The mean vertebral counts for the summer/autumn spawners ranged from 56.29 to 56.45 (169 fish). The range for the winter/spring spawners was from 56.62 to 56.76 (38 fish). The summer/autumn fish made up 82% of the total number and the winter/spring spawners the balance.

The first winter zone of each was noted and the following are the percentage distributions for each race:—

	"Narrow"	"Wide"	Unclassified
Summer/autumn ...	68	24	8
Winter/spring ...	45	55	–

It can be seen that the "Narrows" dominated the summer/autumn spawners, whereas the winter/spring fish had a more even distribution.

The percentages of the nuclear types per race are shown in Table 5. The summer/autumn spawners had otoliths almost entirely (99%) with hyaline nuclei. Though the numbers of winter/spring spawners examined were small they were predominantly (89%) of this type also.

Table 6 summarises the percentage distribution of the first winter zones, per nuclear type, for each race. This shows the "Narrows" dominating (67.6%) in the case of the hyaline type of nucleus.

As the scales were not suitable it was not feasible to calculate the L_1 values of these samples.

SUMMARY

Although a complete range of nuclear types occurred in the samples throughout the main herring season, there is no evidence to show the presence of a summer/autumn component, except for two brief periods in 1960 and 1961 prior to the commencement of the season

proper. The mean vertebral counts during the November/February period reached the known values of winter/spring spawners (56.7-56.9).

The complete range of nuclear types found in the samples could be due to the prolonged spawning period (December to the February following). The "Wide" first winter zone dominated the opaque type of nuclei, while the "Narrow" first winter zone was dominant for the hyaline type nuclei.

In the October samples (1960 and 1961) two distinct races appeared, viz., summer/autumn and winter/spring spawners.

The mean vertebral counts for the summer/autumn spawners ranged from 56.29 to 56.45. The winter/spring spawners had mean vertebral counts ranging from 56.62 to 56.76.

It has been established from the maturity stages and the mean vertebral counts that two races existed together during October 1960 and October 1961. There is no evidence, however, to show that two races occur during the main fishing season (November to February).

Reference

EINARSSON, H., (1951) Racial analysis of Icelandic herrings by means of the otoliths. *Rapp. et. Proc. Verb.* 128 (1) 55-74.

TABLE 1—The percentage distribution of the nuclear types plus the mean Vert(s) for each year

	1960/61		1961/62		1962/63		1963/64	
	%	Mean Vert(s)	%	Mean Vert(s)	%	Mean Vert(s)	%	Mean Vert(s)
Opaque Nuclei	12.9	56.885	10.8	56.958	14.3	56.825	13.6	56.809
		(78)		(38)		(248)		(809)
Hyaline Nuclei	87.1	56.777	89.2	56.816	85.7	56.857	86.4	56.820
		(527)		(314)		(1,490)		(5,147)

(NUMBERS EXAMINED ARE SHOWN IN BRACKETS)

TABLE 2—The percentage distributions of the Wide and Narrow 1st Winter Zones, along with the Mean Vert(s) for each year.

1st Winter Zone	Season	%	Opaque Nucleii		%	Hyaline Nucleii	
			Numbers	Mean Vert(s)		Numbers	Mean Vert(s)
Wide	1960/61	59.0	46	56.891	46.3	244	56.783
	1961/62	50.0	19	56.998	40.2	126	56.803
	1962/63	30.2	75	56.838	27.8	415	56.904
	1963/64	48.7	394	56.904	45.4	2,337	56.861
Narrow	1960/61	38.5	30	56.900	49.9	263	56.779
	1961/62	50.0	19	56.896	57.3	180	56.859
	1962/63	59.3	147	56.788	62.9	937	56.830
	1963/64	49.6	401	56.776	52.6	2,706	56.808
Unclassifiable	1960/61	2.5	2	56.500	3.8	20	56.650
	1961/62	—	—	—	2.5	8	56.875
	1962/63	10.5	26	56.961	9.3	138	56.848
	1963/64	1.7	14	56.800	2.0	104	56.791

TABLE 3—Mean L_1 Values per age class for the "Narrows" and "Wides" for 1960/61, 1961/62 and 1962/63 from Dunmore East

No. of W. Ring	1960/61		1961/62		1962/63	
	Narrow	Wide	Narrow	Wide	Narrow	Wide
1	14.30 (27)	12.57 (3)	14.77 (11)	—	15.48 (45)	11.30 (1)
2	12.53 (146)	11.03 (164)	13.46 (56)	11.41 (26)	14.01 (118)	11.19 (61)
3	13.07 (53)	11.37 (39)	12.37 (84)	10.39 (89)	13.49 (124)	11.67 (69)
4	12.83 (7)	10.79 (9)	13.53 (21)	11.23 (6)	12.68 (159)	10.86 (60)
5	12.71 (7)	11.26 (14)	12.98 (5)	10.65 (8)	13.48 (39)	11.82 (13)
6	12.07 (3)	11.30 (3)	12.15 (11)	11.36 (7)	12.63 (10)	12.06 (5)
7	13.55 (8)	10.92 (15)	14.75 (2)	9.57 (4)	13.03 (23)	10.54 (8)
8	14.47 (3)	10.30 (2)	14.50 (4)	13.00 (2)	13.57 (10)	11.22 (6)
9	—	11.90 (3)	13.32 (4)	—	12.73 (3)	10.05 (2)
	14.33 (3)	10.00 (1)	13.70 (1)	9.90 (3)	12.35 (6)	11.07 (3)

TABLE 4—Combined mean L_1 values per age class for the 1960/63 period.

No. of W. Rings	1960/63	
	Narrow	Wide
1	15.00 (83)	12.25 (4)
2	13.24 (320)	11.11 (251)
3	13.04 (261)	11.03 (197)
4	12.78 (187)	10.88 (75)
5	13.32 (51)	11.33 (35)
6	12.34 (24)	11.58 (15)
7	13.26 (33)	10.61 (27)
8	13.95 (17)	11.39 (10)
9	13.07 (7)	11.16 (5)
9+	13.08 (10)	10.41 (7)
	13.24 (993)	11.06 (626)

TABLE 5—The percentage distributions of the nuclear types and the mean Vert(s) for the two races. October 1960 and 1961 (combined)

	Autumn		Winter	
	%	Mean Vert(s)	%	Mean Vert(s)
Opaque Nucleii	1.0	57.000	11.0	56.250
	(1)		(4)	
Hyaline Nucleii	99.0	56.382	89.0	56.750
	(170)		(32)	

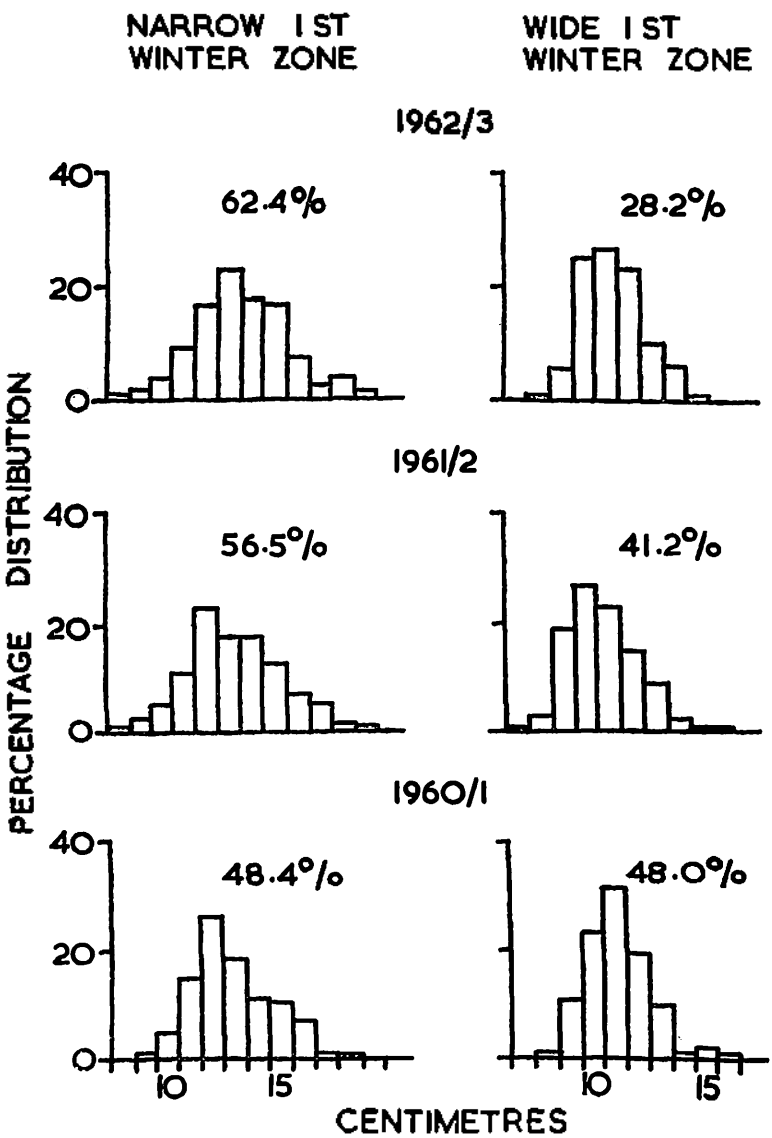
(Numbers examined in brackets)

TABLE 6—The percentage distribution of the Narrow and Wide 1st Winter Zone, per race, per nuclear type along with the mean Vert(s) for October 1960 and 1961 (combined)

1st Winter Zone	Autumn						Winter					
	Opaque Nucleii			Hyaline Nucleii			Opaque Nucleii			Hyaline Nucleii		
	%		Mean Vert(s)	%		Mean Vert(s)	%		Mean Vert(s)	%		Mean Vert(s)
Wide	100	(1)	57.00	24.2	(41)	56.244	50	(2)	56.500	56.3	(18)	56.778
Narrow	—	—	—	67.6	(115)	56.383	50	(2)	56.000	43.7	(14)	56.714
Unclassifiable ..	—	—	—	8.2	(14)	56.786	—	—	—	—		—

(Numbers examined in brackets)

FIG.1. PERCENTAGE L_1 DISTRIBUTIONS FOR THE NARROW AND WIDE 1ST WINTER ZONE OTOLITHS FROM DUNMORE EAST 1960/63



APPENDIX No. 28

DONEGAL BAY MACKEREL INVESTIGATIONS (1963)

by

JOHN P. MOLLOY, B.Sc., Assistant Inspector

There is no established mackerel fishery on the Donegal coast today. At the beginning of this century, large quantities of mackerel were landed in Killybegs and fairly substantial catches were made in 1908/09 but in 1963 only 905 cwt. were taken from March to October, mainly as a by-catch. Monthly landings for 1963 show that some 50% of the total catch was taken in September.

Scientific investigations were started in July 1963 and regular samples were examined from Killybegs. The results obtained are possibly biased since all samples came from by-catches. The numbers of fish examined each month were as follows:—

July	Aug.	Sept.	Oct.	Total
253	281	743	256	1,533

The sampling methods employed were the same as those used in Castletownbere (Molloy, 1962). Fish were examined for length, sex, maturity, dorsal fin, ray count and age. Throughout the period of sampling, small fish, usually immature, dominated in the samples. Large fish were rarely found. In July, the samples were composed mainly of fish with 0, 1 or 2 winter rings on their otoliths. The mean length difference between the 0- group and 1- group fish was approximately 6 cms. (Table 1) indicating that growth during the first year of life was very rapid. The large fish present were mainly full and spent fish. This could possibly indicate the presence of an inshore spawning ground somewhere in Donegal Bay.

In August (Table 2) the majority of fish had 1, 2 or 3 winter rings, indicating that a further ring had been laid down towards the end of July. These fish, which were mostly immature, predominated in the samples during September and October also (Tables 3 and 4), and would be recruits to the adult stocks during the following year. The older fish present during this period were mostly recovering spents.

A comparison of the mean lengths per age class between the Castletownbere and Killybegs fish, shows that those from Killybegs were always slightly smaller. The females were always slightly larger than the males. Monthly age distributions and mean length and mean dorsal fin ray counts, per age class, per sex, per maturity stage per month can be seen in Tables 1 to 4.

Reference

MOLLOY, J. P., (1962) *Annual Report of the Sea and Inland Fisheries, Dublin.*

TABLE I—Showing mean lengths and mean dorsal fin ray count, per age class, per sex, per maturity stage

JULY

Maturity Stages	Sex	Winter Rings								Total
		0	1	2	3	4	6	7	9	
0	Juveniles	12 24.2 11.92	2 23.00 13.00							14
I	M.	73 23.5 12:04	4 25.6 12.00							77
	F.	60 23.6 12.13	5 24.2 11.20							65
II	M.	1 23.2 12.00	20 29.9 11.85	5 30.6 11.60						26
	F.	3 26.7 11.33	14 30.0 11.50	3 31.3 12.00						20
III	M.			2 31.2 10.5						2
	F.		7 30.6 11.57	1 33.7 10.0						8
IV	M.									–
	F.	1 30.3 11.00	2 32.1 12.00							3
V	M.						1 35.4 12.00			1
	F.			1 33.5 11.00	1 34.2 11.00	1 35.5 12.00				3
VII	M.		2 31.3 11.00	2 33.7 11.00						4
	F.			7 31.4 11.85	1 35.0 11.00					8
VIII	M.			2 33.9 11.50	1 34.2 12.00	2 35.9 11.00				5
	F.		4 31.5 11.50	9 31.9 12.00		1 36.0 11.00		2 34.7 11.50	1 39.1 12.00	17
Total males		74 23.5 12.04	26 29.32 11.80	11 31.9 11.27	1 34.2 12.00	2 35.9 11.00	1 35.4 12.00			115
Total females		63 23.8 12.09	31 29.4 11.45	23 31.8 11.82	2 34.6 11.00	2 35.8 11.50		2 34.7 11.50	1 39.1 12.00	124
Juveniles		12 24.2 11.92	2 23.0 13.00							14
TOTAL		149 23.7 12.05	59 29.1 11.66	34 31.8 11.64	3 34.5 11.33	4 35.8 11.25	1 35.4 12.00	2 34.7 11.50	1 39.1 12.00	253
% distribution		58.9	23.3	13.4	1.2	1.6	0.4	0.8	0.4	100

TABLE 2—Showing mean length and mean dorsal fin ray count per age class, per sex, per maturity stage

AUGUST

Maturity Stage	Sex	Winter Rings										Total
		1	2	3	4	5	6	7	8	9	9+	
I	M.	9 25.4 12.00	3 28.6 12.00									12
	F.	14 25.3 11.85										14
II	M.	9 30.8 11.77	72 31.1 11.84	11 33.0 11.09	1 31.6 12.0							93
	F.	5 30.0 12.20	65 31.2 11.80	6 33.0 11.16								76
III	M.		1 35.4 11.0	2 34.1 11.5								3
	F.		14 33.3 11.57	17 34.3 11.58	9 33.7 11.66	1 36.6 11	1 34.6 11	4 36.7 11		2 38.1 10.5	1 38.0 10.0	49
VIII	M.		10 33.7 11.40	6 34.3 11.16	5 34.4 11.80	3 35.2 11.66	4 35.4 11.0	2 36.6 10.5	1 36.4 11		3 37.7 11.33	34
	F.											
Total males		18 28.1 11.88	86 31.4 11.79	19 33.50 11.15	6 33.9 11.83	3 35.2 11	4 35.4 11	2 36.6 10.5	1 36.4 11		3 37.7 11.33	142
Total females		19 26.5 11.94	79 31.6 11.75	23 33.9 11.47	9 33.7 11.66	1 36.6 11	1 36.6 11	4 36.7 11		2 38.1 10.5	1 38.0 10.0	139
TOTAL		37 27.3 11.91	165 31.4 11.23	42 33.7 11.33	15 33.7 11.73	4 35.5 11.00	5 35.2 11.00	6 36.6 10.83	1 36.4 11.0	2 38.1 10.5	4 37.8 11.00	281
% distribution		13.2	58.7	14.9	5.4	1.4	1.8	2.1	0.4	0.7	1.4	100

TABLE 3—Showing mean length and mean dorsal fin ray count per age class, per sex, per maturity stage

SEPTEMBER

Maturity Stages	Sex	Winter Rings										Total
		1	2	3	4	5	6	7	8	9	9+	
I	M.	108 24.9 11.82										108
	F.	96 24.9 11.84										96
II	M.	9 29.4 11.77	55 31.6 11.65	25 32.7 11.76	1 32.9 10							90
	F.	24 27.8 11.75	60 31.6 11.48	10 32.9 11.50	1 32.5 11							95
III	M.		1 31.1 13	1 33.5 12	1 32.8 10							3
	F.	4 31.6 11.75	50 31.6 11.60	21 33.5 11.57								75
VI	M.		1 35.5 11									1
VIII	M.		14 33.4 11.21	52 34.3 11.44	21 34.8 11.19	17 35.0 10.94	11 36.1 10.63	12 36.0 11.00	7 35.9 10.85	4 36.5 11.00	9 37.7 10.66	147
	F.	1 31.2 12	19 32.8 11.57	28 34.0 11.17	19 34.9 11.15	19 35.4 11.42	10 36.4 10.60	15 36.0 12.00	9 37.0 10.66	4 38.5 10.25	4 37.4 10.75	128
Total males		117 25.2 11.82	71 32.0 11.57	78 33.8 11.55	23 34.7 11.08	17 35.0 10.94	11 36.1 10.63	12 36.0 11.0	7 35.9 10.85	4 36.5 11.00	9 37.7 10.66	349
Total females		125 25.7 11.82	129 31.8 11.54	59 33.6 11.37	20 34.7 11.15	19 35.4 11.42	10 36.4 10.60	15 36.0 12.00	9 37.0 10.66	4 38.5 10.25	4 37.4 10.75	394
TOTAL		242 25.5 11.82	200 31.8 11.55	137 33.7 11.47	43 34.7 11.11	36 35.2 11.19	21 36.3 10.62	27 36.0 11.55	16 36.5 10.75	8 37.5 10.62	13 37.6 10.69	743
% distribution		32.6	26.9	18.4	5.8	4.8	2.8	3.6	2.2	1.1	1.8	100

TABLE 4—Showing mean length and mean dorsal fin ray count per age class, per sex, per maturity stage

OCTOBER

Maturity Stage	Sex	Winter Rings										Total
		I	2	3	4	5	6	7	8	9	9+	
I	M.	42 25.53 11.83										42
	F.	36 25.75 11.94										36
II	M.	1 29.0 11	16 30.5 12.12	23 31.6 11.86	1 33.5 11.0							41
	F.	5 27.82 12.4	14 30.9 11.64	14 31.5 12.22	1 31.9 10							34
III	M.											
	F.			1 32.8 11.0		2 34.2 12.00				1 37.6 12		4
VIII	M.			6 33.19 11.16	4 35.0 11.25	9 35.1 11.22	4 35.1 11.25	5 35.42 11.20	8 37.0 10.87	3 35.7 11.33	8 38.1 10.50	47
	F.		1 34.0 11	7 34.0 11.42	4 35.2 11.00	7 35.5 11.57	15 36.2 11.06	3 36.8 10.66	6 35.8 10.66	2 36.5 11.00	7 37.7 11.14	52
Total males		43 25.6 11.81	16 30.5 12.12	29 32.1 11.72	5 34.7 11.12	9 35.1 11.22	4 35.1 11.25	5 35.4 11.20	8 37.0 10.87	3 35.7 11.33	8 38.1 10.50	130
Total females		41 26.0 12.00	15 31.1 11.60	22 32.4 11.90	5 34.5 10.80	9 35.2 11.66	15 36.2 11.06	3 36.8 10.66	6 35.8 10.66	3 36.9 11.33	7 37.7 11.14	126
TOTAL		84 25.8 11.90	31 30.8 11.87	51 32.2 11.80	10 34.6 10.96	18 35.1 11.44	19 36.0 11.10	8 35.9 11.00	14 36.5 10.78	6 36.4 11.33	15 37.9 10.80	256
% distribution		32.8	12.1	19.9	3.9	7.0	7.4	3.1	5.5	2.4	5.9	100

APPENDIX No. 29

MACKEREL INVESTIGATIONS OFF THE SOUTH COAST OF IRELAND (1962-63)

by

JOHN P. MOLLOY, B.Sc., Assistant Inspector

Background

At the beginning of this century mackerel fishing around the coasts of Ireland was flourishing, particularly off the south and south-west coasts. Over the years, however, landings gradually declined, the mean annual catch for the period 1954-1963 being 21,000 cwt. as compared with a mean of 353,000 cwt. for the first decade of the century (Figure 1). Up to about 1930, mackerel fishing was seasonal and was divided into two separate phases. The spring fishery, which lasted from December/January until May/June, was the more important and accounted for 70% of the total landings. The smaller fishery, an autumn one, lasted from August to November. During the spring fishery, boats concentrated on shoals of mackerel which approached the south coast with the onset of spawning. From 1900 to 1909 the main shoals were located off Kinsale and Baltimore. Failure of these shoals to appear in certain years was largely attributed to the low temperature of inshore waters. Many Irish boats attended the fishery together with larger English, Scottish, Manx and French drifters and seiners. In 1905, large purse seines used in America began to take the place of the lighter traditional seines. After 1910 the landings from the spring fishery, which had been the mainstay of the industry began to decline. This decline was not due to a failure of the south coast fishery but was caused by a contracting demand on the American market where the bulk of the catch was sold in pickled form. Comparatively large quantities of mackerel were again taken by foreign vessels from 1932 to 1938 off the south coast of Ireland, representing approximately 29% of all mackerel caught in European waters (Fig. 2). This percentage declined considerably during the second world war. From 1950 to 1959, 13% of all mackerel landed in continental ports again came from the southern Irish waters; Irish boats contributed only 1-2% of this total as against 5% of the pre-war figure (Fig. 2). An interesting comparison between French and Irish mackerel catches off the south coast of Ireland in the 1955-59 period is shown in Table 1 (These figures are taken from the International Bulletin Statistique 1932-1961). These figures confirm the unimportant part that Irish boats played in the overall landings.

Garstang (1900) made a study of the mackerel off the south coast of Ireland. A summary of his results showed that in March moderately large fish arrived off the coast. By the end of June the proportion of large fish was greatly reduced and there was a considerable influx of small immature mackerel. The large fish had all disappeared by

the end of July and from then onwards the young mackerel remained close to the shore. These small fish were presumed to be future recruits to the adult fishery. Growth measurements showed that the major portion of the growth increment was laid down during this period of the life cycle. In 1936, scientific investigations were commenced in the Celtic Sea on the mackerel populations of southern Irish waters and the entrance to the English channel. The principal aim of this work was to delimit the mackerel spawning area and to follow the subsequent dispersal pattern of larval and post-larval stages. Ireland, France and England participated in this joint effort. The results of the Irish cruise, which took place in April, 1938, were published (Farran, 1939) and showed that the greatest concentration of eggs (96,000 per half-hour haul) were found between 9° and 10° west, 50 miles south of the Fastnet. Larval mackerel were found only in small quantities and these, it was concluded, came from some slightly earlier spawning in the extreme western part of the area (11° W.). The result of the completed investigations (Corbin, 1947) showed that the spawning started in mid-March, rapidly reached a peak in mid-April, declined gradually through May and June and was very slight at the end of July. The changes in intensity of spawning were accompanied by the continuous shift eastwards and slightly northwards of the spawning area. In March spawning occurred in a small area on the western edge of the continental shelf. In mid-April, it was spread over the greater part of the Celtic Sea, with the main activity concentrated in two centres, one to the south of Ireland and the other to the west of the English Channel. By the May/June period it had shifted further to the east and occupied the central area of the Celtic Sea. In July, there was no spawning westward of the Scilly Isles. The spawning then seemed to be confined to the shallow waters of the continental shelf.

Recent Investigations

Preliminary investigations into the stocks of mackerel off the south coast of Ireland commenced in September, 1962. Samples were obtained from various points there and examined for length, sex, maturity, first dorsal fin ray counts and age. Only 844 fish were examined as the main season was approaching a close. In May, 1963, sampling was resumed and continued throughout the season until November. Castletownbere was selected as the major sampling port as landings there since 1961 had been the heaviest recorded along the south coast. No boats were fishing exclusively for mackerel during 1963 out of Castletownbere and the results obtained from the sampling carried out were based on a by-catch in *Nephrops* and whiting fisheries. Therefore, they were possibly biased to some extent. The monthly figures of fish examined were as follows:—

May	June	July	Aug.	Sept.	Oct.	Nov.	Total No. of fish examined
327	778	664	467	747	867	114	3,964

In May and June, the maturities of the fish varied and included most stages of development. This could be indicative of a prolonged spawning or, alternatively, a mixture of races (Tables 2 and 3). Since some of these fish were caught very close to the shore at Black Ball Head in an advanced maturity stage, it was concluded that a spawning ground existed in this region. In June, large numbers of small fish appeared in the catches and dominated up to end of August, (Table 3). These fish were mostly immature and would not have spawned during 1963. In August, September, October and November, the older fish were all in the recovering spent (stage VIII) condition. As the season continued, the older fish (8, 9 and more winter rings) became increasingly prominent. The mean length per age class per sex (Table 4) showed that the females were always slightly larger than the males. Monthly tables showing the mean lengths, mean dorsal fin ray counts per age class, per maturity stage, per sex are given in Tables 2 to 8. The age distribution varied considerably. In May, fish with 7 winter-rings were dominant, while those with 4 winter-rings were also well represented. In June, the large influx of young fish changed the age distribution completely but the same dominant and sub-dominant age group were present in the older fish as in May. In July, the 4 winter-ring fish which were well represented in earlier age distributions were replaced by fish with 3 winter-rings. In August, the 5 winter-ring fish in the catches dominated. During September, October and November, there was a notable increase in the percentage of fish with 8, 9 and more winter-rings.

References

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FARRAN, G. P., (1939) *Rapp. Cons. Explor. Mer.* Vol. CX4.

CORBIN, P. G., (1947) *Journ. Mar. Biol. Assoc.* Vol. XXVII No. 1, P.65.

STEVEN, G. A., (1948) *Journ. Mar. Biol. Assoc.* Vol. XXVII No. 3, P.517.

TABLE 1.

Quantities of mackerel taken (cwt) by French and Irish boats in sea area VII g-k. 1955-1960. (South Coast of Ireland).

Year	*French*	*Irish*
1955	170,471	6,581
1956	197,838	10,117
1957	267,249	18,386
1958	198,526	28,880
1959	276,266	21,630
1960	246,286	32,927

TABLE 2—Showing mean length and mean dorsal fin ray count per age class, per sex, per maturity stage.

MAY

Maturity Stage	Sex		Winter Rings 1	2	3	4	5	6	7	8	9	9+	Total
II	M.	No.	3	1									4
		M.L.	29.7	32.3									
		M.D.F.C.	11.00	11.00									
	F.			1									1
				29.2									
				12.00									
III	M.		3	1	3	8				1			16
			31.4	31.6	32.9	34.6				39.2			
			11.00	13.00	12.00	11.75				11.00			
	F.			1								2	3
				32.5								37.1	
				11.00								12.5	
IV.	M.		2	1	2		1		1	1		2	10
			30.3	29.5	34.5		36.2		38.6	36.8		38.6	
			13.00	13.00	13.00		12.00		11.00	10.00		9.5	
	F		2	3	5		1	5	1	2		1	20
			33.3	34.0	33.7		36.1	36.6	36.5	37.9		37.6	
			11.00	11.66	11.60		11.00	10.50	10.00	12.50		11.00	
V	M.		4	3	9	8	1	6	5	1	3	3	43
			32.6	33.1	33.5	34.7	34.4	35.9	36.4	38.5	37.1	38.1	
			11.50	11.66	11.66	12.15	12.00	10.83	11.60	10.00	11.33	11.66	
	F.			4	8	3	2	5	22	8		6	58
				33.9	34.7	36.6	36.3	36.8	36.6	37.6		38.5	
				11.75	12.00	11.66	11.00	10.80	11.04	11.0		11.00	
VI	M.		1	9	12	3	6	11	23	2	3	6	76
			30.5	32.8	34.2	34.5	36.5	36.3	36.2	36.9	36.9	37.9	
			11.00	11.88	11.84	12.00	11.33	11.09	11.34	10.50	10.66	10.50	
VIA	F.			4	5	3	1	2	2	1	1	1	20
				33.0	33.9	33.4	37.5	36.3	38.0	38.0	39.3	37.2	
				11.50	12.02	11.66	14.00	11.50	11.0	11.0	11.0	10.0	
VIB	F.			1	2	2	1	3	8	1		5	23
				32.4	35.3	36.1	36.5	37.3	36.8	38.2		40.2	
				12.00	12.00	11.50	10.00	11.33	10.87	10.00		11.00	
VII	M.		2	1	4	2	1	4	1		1	2	18
			30.5	31.6	33.8	34.5	34.2	36.4	36.3		38.3	36.8	
			12.00	12.00	11.75	12.50	11.00	11.50	12.00		11.00	10.5	
	F.			1	3	7	2	1	2	1		4	21
				32.7	34.7	34.7	35.4	36.5	38.0	37.9		37.5	
				11.00	10.50	11.71	10.50	10.00	10.50	11.00		11.50	
VIII	M.					1				1	1		3
						34.9				35.8	37.6		
						12.00				13.00	12.00		
	F.				1	5	3	1	1				11
					34.5	34.9	35.3	36.2	37.1				
					12.00	11.40	11.33	11.00	12.00				
Total animals			15	16	30	22	9	21	30	6	8	13	170
			31.0	32.5	33.8	34.6	36.0	36.2	36.3	37.3	37.6	37.9	
			11.75	11.94	11.87	12.0	11.44	11.09	11.40	10.83	11.12	10.61	
Total females				14	22	25	10	17	36	13	1	19	157
				32.9	34.3	34.8	35.9	36.7	36.8	37.7	39.3	38.5	
				11.57	11.86	11.60	11.20	10.76	10.97	11.15	11.00	11.21	
TOTALS			15	30	52	47	19	38	66	19	9	32	327
			31.0	32.7	34.1	34.7	36.0	36.5	36.6	37.6	37.8	38.2	
			11.75	11.77	11.86	11.79	11.31	10.95	11.67	11.05	11.11	11.00	
% distribution			4.6	9.2	15.6	14.4	5.8	11.7	20.3	5.8	2.8	9.8	100

TABLE 3—Showing mean length and mean dorsal fin ray count per age class, per sex, per maturity stage

JUNE

Maturity Stage	Sex	Winter Rings 0	1	2	3	4	5	6	7	8	9	9+	Total
0	No. M.L. M.D.F.C.	1 22.9 14.00											1
I	M.	65 25.1 11.72	2 29.6 12.5										67
	F.	60 25.2 11.78	1 28.6 15.00										61
II	M.	10 25.9 11.60	71 29.7 11.98	1 32.6 12.00									82
	F.	11 25.8 11.81	50 29.7 11.90	1 29.6 12.00									62
III	M.	2 26.0 12.50	67 29.8 11.92	4 31.5 11.25	2 33.3 11.00	1 35.8 11.00							76
	F.	3 26.5 11.66	113 29.6 11.94	7 32.4 11.71	3 33.0 11.33								126
IV	M.	1 25.4 13.00	32 29.5 12.06	2 34.9 11.50	1 34.0 13.00								36
	F.		62 30.0 11.96	7 33.11 11.57	8 33.6 11.33		1 30.5 11.00	1 36.8 11.00	1 36.7 10.00				80
V	M.		25 30.1 11.88	3 33.1 11.66	3 33.0 11.00	4 34.5 11.50	1 34.2 11.00					2 38.2 11.50	38
	F.		10 30.0 11.60	9 32.8 11.32	2 34.2 12.50	3 34.1 11.00		1 36.3 11.00	4 36.1 10.75	1 37.5 11.00	1 37.3 11.00	1 38.6 11.00	32
VI	M.		7 30.1 12.14	3 32.6 11.33	2 33.9 11.00	4 34.7 11.50			1 36.6 11.00	2 38.4 11.50		2 36.9 12.00	21
VIA	F.		6 30.0 12.33	7 33.7 11.85	4 34.3 10.75	1 33.7 12.00		1 37.0 12.00	3 36.4 11.00			4 38.8 10.75	26
VIB	F.		2 30.1 13.50		5 34.3 12.00	2 33.1 12.00			3 37.3 10.66				12
VII	M.		8 30.1 11.87		1 32.2 10	4 34.7 11.50	3 35.3 10.66		4 36.5 10.25	1 38.7 11.00	1 36.0 11.00	1 36.8 11.00	23
	F.		3 30.9 11.33	1 33.1 10.00	1 32.7 11.00	1 34.8 10.00	1 35.6 12.00	2 36.6 10.00	5 36.5 11.00	1 37.4 10.00		1 38.0 11.00	16
VIII	M.		2 30.3 12.00	5 33.8 12.00	2 34.4 12.00				2 36.3 10		1 36.4 11		12
	F.		2 31.6 11.00		1 32.7 11.00	3 34.7 11.33			1 35.7 10				7
Total males		78 25.2 11.74	214 29.8 11.97	18 33.0 11.66	11 33.5 11.27	13 34.7 11.38	4 35.0 10.75		7 36.4 10.28	3 38.5 11.33	2 36.2 11.00	5 37.4 11.60	355
Total females		74 25.4 11.78	249 29.8 11.94	32 32.9 11.56	24 33.8 11.45	10 34.1 11.30	2 33.1 11.50	5 36.7 10.80	17 36.5 10.76	2 37.5 10.50	1 37.3 11.00	6 38.6 10.83	422
Sex not ascertainable		1 22.9 14											1
TOTALS		153 25.3 11.77	463 30.0 11.95	50 32.9 11.60	35 33.7 11.40	23 34.5 11.34	6 34.4 11.00	5 36.7 10.80	24 36.5 10.62	5 38.1 11.00	3 36.6 11.00	11 38.1 11.18	778
% distribution		19.7	59.5	6.4	4.5	3.0	.8	.6	3.1	.6	.4	1.4	100

TABLE 4—Showing mean length and mean dorsal fin ray count per age class, per sex, per maturity stage

JULY

Maturity Stage	Sex		Winter Rings 0	I	2	3	4	5	6	7	8	9	9+	Total
I	M.	No. M.L. M.D.F.C.	1 25.9 11.00	18 27.9 11.00	3 30.4 11.66									22
	F.			5 27.9 12.20										5
II	M.		2 27.2 12.00	52 30.9 12.03	54 31.8 11.51	4 32.5 11.75	1 33.9 11.00							113
	F.		4 27.3 11.75	36 29.6 11.75	16 31.2 11.75	3 33.8 11.33	1 33.2 12.00							60
III	M.			9 30.9 12.33	9 32.0 10.77	6 33.41 11.16								24
	F.			29 30.9 11.75	75 32.7 11.46	24 33.7 11.37	11 34.1 11.27	3 36.5 11.66	2 36.5 11.50	11 36.9 11.18		1 39.6 11.0	3 37.9 11.33	159
IV	M.			2 33.3 11.00	1 33.2 13.00	1 33.8 12.00	1 36.5 11.00	1 35.5 10.00			1 37.6 12.00			7
	F.			2 30.8 12.00	3 33.4 12.33	3 34.4 10.33	6 34.6 11.33	2 36.5 12.00		1 38.4 11.00			1 37.5 12.00	18
V	M.			4 31.4 12.25	6 33.5 12.33		1 34.4 12.00	3 36.3 11.33	2 35.6 11.50	1 35.0 11.00				17
	F.					5 34.0 10.80	2 36.1 10.5	7 35.8 12.00	1 36.8 11.00	3 36.8 11.00	4 37.9 10.75	2 37.6 11.50		24
VI	M.			2 32.8 12.50	3 32.7 12.00	1 36.4 10.00	3 34.9 11.33	2 34.9 11.50		8 37.3 10.75	2 36.6 11.50		2 38.3 12.50	23
VIA	F.						1 35.5 12.0	1 34.7 10.00						2
VIB	F.				1 33.0 11.0	1 34.0 10.0	1 35.7 14.0	1 35.3 11.0	1 37.2 10.0	3 37.8 10.33				8
VII	M.			1 32.3 11.0		10 34.6 10.8	7 35.5 10.85	8 36.8 11.12	10 38.2 10.60	9 37.5 10.88	3 38.0 11.0	1 35.4 10	5 38.4 11.0	54
	F.			1 32.2 13.0	6 32.8 11.16	4 34.7 11.75	5 35.12 11.00	3 36.7 11.0	1 38.5 12.0	8 37.7 10.5		2 38.5 11.00		30
VIII	M.			6 32.4 11.66	33 33.7 11.06	19 33.7 11.73	7 34.4 11.57	6 35.9 10.66	4 35.8 11.25	7 35.6 10.57	1 38.7 11.00		2 37.2 11.50	85
	F.			1 29.7 12.0	4 33.0 11.50		2 35.7 10.50		1 39.1 12.00	3 36.1 11.00	1 37.2 10.00	1 36.9 11.00		13
Total males			3 26.8 11.66	94 30.5 11.92	109 32.5 11.38	41 33.8 11.39	20 34.9 11.25	20 36.2 11.00	16 37.3 10.87	25 36.8 10.76	7 37.6 11.28	1 35.4 10.0	9 38.2 11.44	345
Total females			4 27.3 11.75	74 30.1 11.81	105 32.5 11.51	40 34.0 11.17	29 34.7 11.27	17 36.0 11.58	6 37.4 11.33	29 37.2 10.86	5 37.8 10.60	6 38.1 11.16	4 37.8 11.50	319
TOTALS			7 27.1 11.71	168 30.3 11.87	214 32.5 11.47	81 33.9 11.28	49 34.8 11.26	37 36.1 11.27	22 37.3 11.00	54 37.0 10.81	12 37.7 11.00	7 37.7 11.0	13 38.1 11.46	664
% distribution			1.0	25.3	32.3	12.2	7.4	5.6	3.3	8.1	1.8	1.0	2.0	100

TABLE 5—Showing mean length and mean dorsal fin ray count per age class, per sex, per maturity stage

AUGUST

Maturity Stage	Sex	Winter Rings										Total
		I	2	3	4	5	6	7	8	9	9+	
I	M.	76 27.7 11.88	13 30.5 11.84									89
	F.	44 27.6 11.88	2 29.1 12.00									46
II	M.	7 28.6 12.42	48 31.7 11.52	8 32.5 12.5	1 31.8 12.0							64
	F.	16 30.1 11.81	38 31.1 11.60	2 33.3 11.0								56
III	M.		1 31.5 11.0									1
	F.	1 30.0 13	15 33.5 11.53									16
IV	F.				3 34.5 10.66	3 36.4 11.33	1 37.0 13	2 37.5 10.50	1 39.5 12.0		4 39.2 10.75	14
VII	M.		3 31.8 11 00	1 33.9 10.0	2 34.2 11.5	1 36.0 11.0		2 36.9 11.50		2 37.8 10.5	7 37.5 11 00	18
	F.					1 36.6 12						1
VIII	M.		16 33.0 10.93	8 33.2 11.25	11 34.7 10.9	16 35.7 11.18	2 37.4 11	18 36.1 11.22	4 36.2 11.0	1 36.5 10.0	5 37.3 11.40	81
	F.			17 33.7 11.17	16 34.5 11.12	20 35.5 11.55	7 36.5 11.14	11 36.9 11.27	3 38.3 10.0	4 38.1 10.75	3 38.7 11.00	81
Total males		83 27.7 11.92	81 31.8 11.43	17 32.9 11.76	14 34.4 11.07	17 35.8 11.17	2 37.4 11.0	20 36.2 11.25	4 36.2 11.0	3 37.4 10.33	12 39.0 10.85	253
Total females		61 28.3 11.88	55 31.7 11.60	19 33.7 11.15	19 34.5 11.05	24 35.7 11.54	8 36.5 11.37	13 37.0 11.16	4 38.6 10.5	4 38.5 10.75	7 37.4 11.16	214
TOTALS		144 28.0 11.90	136 31.6 11.50	36 33.3 11.44	33 34.5 11.06	41 35.7 11.39	10 36.7 11.30	33 36.5 11.21	8 37.4 10.75	7 38.0 10.57	19 38.0 11.05	467
% distribution		30.8	29.1	7.7	7.1	8.8	2.1	7.1	1.7	1.5	4.1	100

TABLE 6—Showing mean length and mean dorsal fin ray count per age class, per sex, per maturity stage

SEPTEMBER

Maturity Stage	Sex	Winter Rings										Total
		1	2	3	4	5	6	7	8	9	9+	
I	M.											
	F.	1 26.8 10										1
II	M.	1 32.5 12	11 32.5 11.63	2 33.3 11								14
	F.		5 31.4 11.40									5
III	M.											
	F.		3 32.8 11		1 36.2 12	4 36.0 10.75	1 35.7 10	1 37.0 11	1 37.5 11	1 38.3 11	2 37.4 10.0	14
VII	M.			2 34.2 11.5	1 35.5 12	1 35.0 11	3 36.0 10.66	3 36.0 11.66	4 36.6 10.75	1 36.6 11	3 39.4 11.33	18
	F.			3 34.1 11.0	2 34.8 10.5	12 36.2 11.16	9 36.4 11.0	6 35.4 11.33	5 37.8 11.60	1 39.0 9	8 38.9 11.12	46
VIII	M.		16 32.9 11.31	14 34.5 11.57	41 34.7 11.07	91 35.6 11.06	52 35.6 11.17	68 36.3 11.08	42 36.6 10.97	43 37.1 10.76	32 37.9 11.03	399
	F.		8 32.1 11.62	22 34.5 11.45	21 34.9 11.52	66 35.6 10.98	41 37.2 11.60	36 36.6 11.11	26 37.4 10.80	16 37.9 11.18	14 37.7 10.28	250
Total males		1 32.5 12	27 32.7 11.44	18 34.3 11.50	42 34.7 11.09	92 35.6 11.06	55 35.6 11.14	71 36.3 11.11	46 36.6 10.95	44 37.1 10.77	35 38.0 11.05	431
Total females		1 26.8 10	16 32.0 11.43	25 34.4 11.40	24 35.0 11.45	82 35.7 11.00	51 37.0 11.47	43 36.5 11.13	32 37.4 10.93	18 38.0 11.05	24 38.0 10.33	316
TOTAL		2 29.7 11	43 32.5 11.44	43 34.4 11.44	66 34.8 11.22	174 35.6 11.03	106 36.3 11.30	114 36.4 11.11	78 37.0 10.94	62 37.4 10.85	59 38.0 10.75	747
% distribution		.3	5.8	5.8	8.8	23.3	14.2	15.3	10.4	8.3	7.8	100

TABLE 7—Showing mean length and mean dorsal fin ray count per age class, per sex, per maturity stage

OCTOBER

Maturity Stage	Sex	Winter Rings										Total
		1	2	3	4	5	6	7	8	9	9+	
II	M.	2 31.0 12	21 31.2 11.80	2 31.3 11.50								25
	F.	2 30.0 10.5	20 31.7 12.10	2 32.1 11.50								24
III	M.											
	F.		1 32.7 11									1
VII	M.											
	F.				1 34.7 11	1 36.1 11	1 36.8 10					3
VIII	M.	2 33.3 11.00	22 33.0 11.22	38 34.2 11.73	44 35.0 11.29	81 35.22 11.18	67 35.5 11.11	52 36.3 10.96	53 36.8 11.07	29 37.5 10.89	81 38.1 10.74	469
	F.	1 31.5 12	18 33.3 11.83	35 34.33 11.57	40 34.9 11.15	49 35.5 11.32	50 36.3 11.04	28 37.1 10.92	49 37.2 10.67	21 37.6 11.09	54 37.2 10.85	345
Total males		4 32.1 11.50	44 32.1 11.50	40 34.1 11.72	44 35.0 11.29	81 35.2 11.18	67 35.5 11.11	52 36.3 10.96	53 36.8 11.07	29 37.5 11.09	81 38.1 10.74	495
Total females		3 30.5 11.0	38 32.5 11.97	37 34.2 11.56	41 34.9 11.14	50 35.5 11.32	51 36.3 11.01	28 37.1 10.92	49 37.2 10.67	21 37.6 11.09	54 37.2 10.85	372
TOTAL		7 31.4 11.28	82 32.3 11.71	77 34.1 11.64	85 34.9 11.22	131 35.3 11.23	118 35.8 11.07	80 36.6 10.95	102 37.0 10.88	50 37.6 10.98	135 37.7 10.78	867
% distribution		0.8	9.4	8.9	9.8	15.1	13.6	9.2	11.8	5.8	15.6	100

TABLE 8—Showing mean length and mean dorsal fin ray count per age class, per sex, per maturity stage

NOVEMBER

Maturity Stages	Sex	Winter Rings									Total
		2	3	4	5	6	7	8	9	9+	
II	M.	1 29.4 12.0									1
	F.	2 31.6 12									2
VIII	M.	2 34.2 11.50	6 34.6 11.33	9 34.8 11.44	12 34.8 11.58	4 35.3 11.25	6 36.5 11	11 36.4 11.09	1 36.6 11.00	13 38.6 10.61	64
	F.		6 34.5 11.33	5 35.3 11.80	8 35.4 11.25	4 36.9 11.75	2 37.4 10.5	4 36.5 11.25	3 37.4 11.00	8 38.2 10.63	40
III	M.						2 36.4 12.5		1 36.8 10.0	4 38.2 10.75	7
	F.										
Total males		3 32.6 11.66	6 34.6 11.33	9 34.8 11.44	12 34.8 11.58	4 35.3 11.25	6 36.5 11.00	11 36.4 11.09	1 36.6 11.00	13 36.8 10.61	65
Total females		2 31.6 12.00	6 34.5 11.33	5 35.3 11.80	8 35.4 11.25	4 36.9 11.75	4 36.9 11.50	4 36.5 11.25	4 37.3 10.75	12 38.2 10.66	49
TOTAL		5 32.2 11.80	12 34.6 11.33	14 35.0 11.57	20 35.0 11.45	8 36.1 11.50	10 36.7 11.20	15 36.5 11.20	5 37.1 10.8	25 38.4 10.64	114
% distribution		4.4	10.5	12.3	17.5	7.0	8.8	13.2	4.4	21.9	100

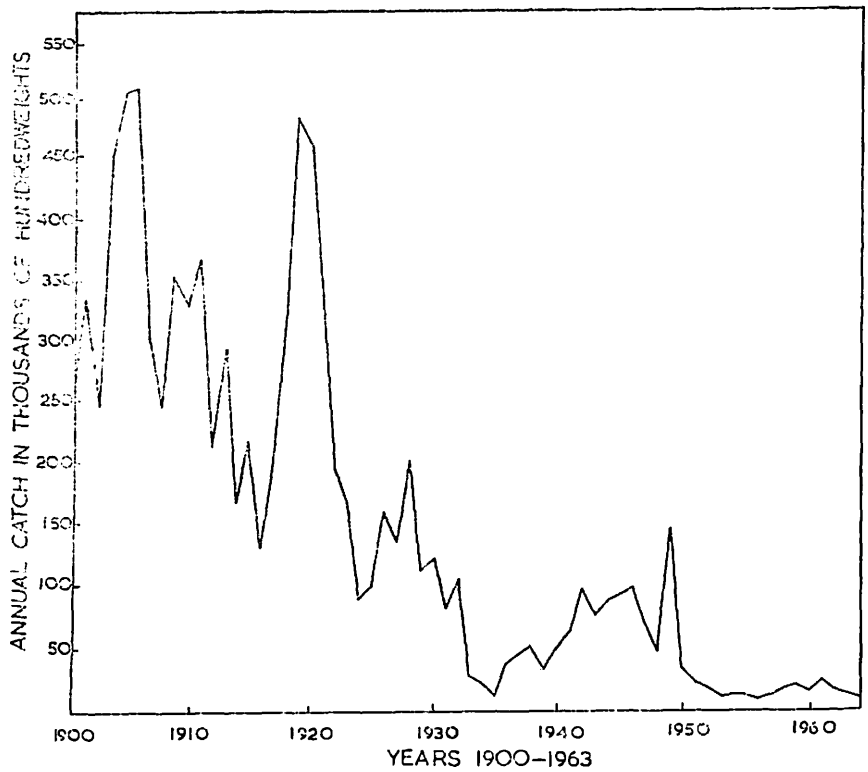

ANNUAL CATCH IN THOUSANDS OF HUNDREDWEIGHTS
550
500
450
400
350
300
250
200
150
100
50
1900
1910
1920
1930
1940
1950
1960
YEARS 1900–1963

Fig. 1

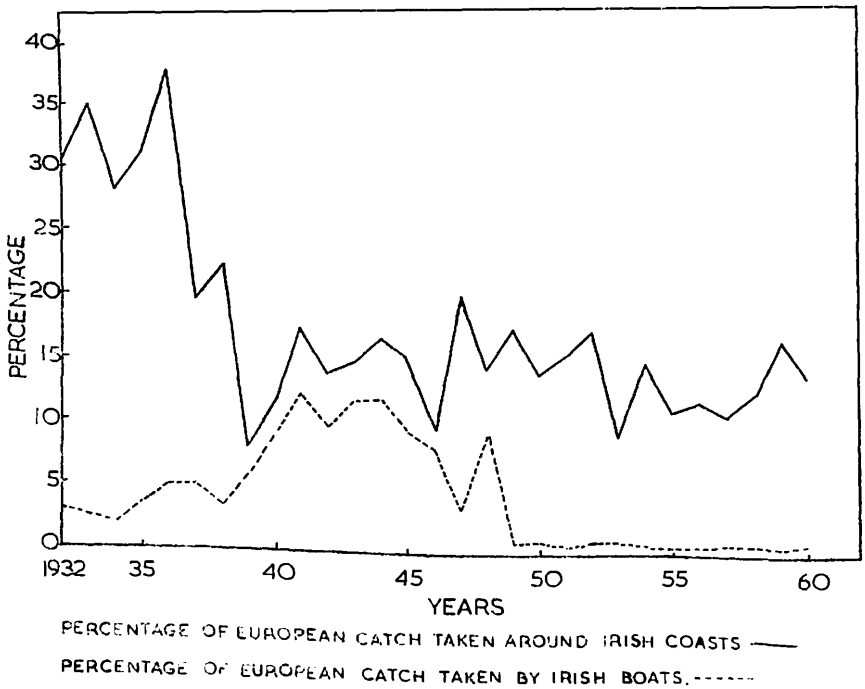

PERCENTAGE
40
35
30
25
20
15
10
5
0
1932
35
40
45
50
55
60
YEARS
PERCENTAGE OF EUROPEAN CATCH TAKEN AROUND IRISH COASTS ——
PERCENTAGE OF EUROPEAN CATCH TAKEN BY IRISH BOATS.------

Fig. 2

APPENDIX No. 30

MOULTING OF LOBSTERS

by

F. A. GIBSON, PH.D., Inspector of Fisheries

Lobsters increase in length and weight by a process called *ecdysis* or moulting. The effect of this is that at certain intervals the lobster completely casts its hard outer shell and emerges as a soft shelled animal which is larger and heavier. This method of growth is not confined to lobsters; it is found in other *crustacea* such as crabs, crawfish, prawns and shrimps. In general, it may be said that the younger the lobster the more frequently it casts its shell. As maturity approaches, so the number of casts per annum decreases. Just before maturity a lobster may cast twice or even three times in a period of twelve months, but after maturity this may be reduced to once a year and later to once every two years or, perhaps, even three years. Mature females carry their eggs for a period of eight to ten months and only cast their shells every second year. Males, as a rule, therefore, cast more frequently than females.

In recent years a large number of lobsters of recorded lengths have been liberated into the sea around our coasts. From recaptures of naturally moulted lobsters, it has been possible to estimate the rate of growth per moult in the case of lobsters of different sizes. It remains to be determined, however, how often moulting takes place per year in lobsters of various sizes. The growth at each moult has been found to be remarkably constant in the case of mature lobsters, i.e. lobsters of 80 mm. carapace length and upwards. It has been found that mature males increase in length by about 8.3 mm. and females by about 7.7 mm. at each moult. Thus it would seem that males grow slightly faster per moult and, since females miss a moult when they are carrying their eggs, males may have additional moults per year which would further increase their annual rate of growth.

A closer look at the process of moulting is of interest. The first indication that moulting is about to take place is seen when the gap between the head and tail regions of the old shell starts to widen. Slowly, the entire head region is lifted off in one piece. This brings with it the coverings of the eyes and the gills. The process of lifting the head region takes about twenty-five minutes. Having got rid of the head region, the lobster, using its legs and tail for purchase power, commences by an irregular series of jerks to haul itself from the tail region of the old shell. It takes about ten minutes to drag the tail free. By now, the lobster is attached to its old shell only by means of the legs and claws. The legs are easily withdrawn but the claws present a more difficult problem. The lobster makes violent movements of its tail, and with each series of kicks, the new claws emerge a little. This action continues for almost thirty minutes before the new claws are finally free of the old ones. At this state the lobster, being completely separated from its old shell, is most vulnerable,

because every part of its new shell is so soft that with only a little pressure one could drive one's finger through it. The natural question arises as to how a larger new shell emerges from a smaller old shell. The lobster accomplishes this seeming impossibility by reducing its water content prior to moulting. In this way, water is lost from all parts which thus shrink but, as soon as the new shell is exposed, the animal starts taking up water and thus swells to its new size. The water acts like the air in a football and bladder. The only way to extract the bladder is to let the air out. If the bladder has to fit a new and larger cover, then more air than it contained in the old cover is blown into it. The air performs the same release and refilling task in the case of a football that water performs in the case of a lobster.

Moulting takes place over a considerable part of every year but may be limited to the period when lobsters are most active, that is, from April to November. It appears that moulting is most common in July, although it can vary from year to year and place to place. In July, catches often fall off, which one would expect to be the case if a large number of lobsters are casting their shells at that time. It is not certain how long the actual process of casting takes or how long the new soft shell takes to harden in nature. From time to time, lobsters have been observed casting their shells in the various lobster ponds on the Irish coasts and some specimens of moulting lobsters have been placed in floating boxes to observe their rate of return to the hard condition. Before the summer of 1963 it had been the practice to put the soft lobtsers individually into floating boxes without their old shells. In July, 1963, three lobsters, after casting their shells, were placed in separate boxes and their old shells were included in the boxes with them. After seven days it was noted that most of the old shells had been eaten and that the lobsters had hardened off sufficiently to be placed with other lobsters in the pond. This suggests that the soft lobster eats its shell, thereby obtaining a large extra supply of calcium which serves to harden the new skin. This may possibly also occur in nature. If so, it could help to explain the falling off of catches in late summer followed by a catch of large numbers of clean shelled, but not completely hardened, lobsters in the autumn.

The three specimen lobsters referred to above had the following pre-moult and post-moult measurements:—

No.	Pre-moult		Post-moult (approximately 3 days later)			
	Carapace length in m.m.	Weight in ozs.	Carapace length in mm.	Weight in ozs.	Percentage increase	
					Carapace	Wt.
1	81	10	91	18¼	11.0	85
2	80	9½	88	14¼	10.0	47
3	104	24	110	32	5.8	33

The results shown must not be taken as representative of all lobsters but they do illustrate the very considerable increase in length and weight, particularly in small lobsters, which can take place after moulting. The two first-mentioned specimens were just under the legal size limit before moulting. Since lobsters are invariably purchased by weight today, fishermen will be recompensed within a short time by added weight and increased marketability if they return all undersized ones to the sea.

APPENDIX No. 31

THE EFFECT OF TEMPERATURE ON THE EDIBILITY AND KEEPING QUALITY OF SEA FISH

by

DESMOND MCCARTHY, B.A., B.A.I., Assistant Engineer

1. It is well recognised that fish deteriorates rapidly at ordinary air temperatures and eventually gives off objectionable odours and becomes inedible. It has been demonstrated that this tendency can be significantly delayed if the temperature of the fish is kept low by the use of ice in the container in which the fish is held.

2. An investigation of the temperatures of fish, both iced and uniced, was carried out in Ireland from March, 1961, to November, 1962, in order to compare the fluctuation in temperatures of both from time of catching to the point of retailing or processing.

3. The ports at which the investigations were set in train were Killybegs, Galway, Dingle, Castletownbere, Howth and Skerries.

4. The temperatures of the fish under investigation were recorded at intervals of about three hours, except during night, from the time of landing on the deck of the fishing boat until delivery to the retailers. The annexed diagrams illustrate the fluctuations observed. The average of each set of temperature readings is shown in the following table as also is the overall average for all the samples investigated.

Port	Average temperature of fish with ice		Average temperature of fish without ice	
	C°	F°	C°	F°
Killybegs	2.2	36	10.2	50.4
Castletownbere ..	1.0	33.8	—	—
Galway	0.0	32	10.0	50.0
Howth (1)	—	—	13.5	56.3
Howth (2)	6.5	43.7	14.0	57.2
Dingle	3.0	37.4	13.0	55.4
Skerries	2.0	35.6	8.0	46.4
AVERAGE ..	2.4	36.32	11.4	52.5

5. The Torry Research Station at Aberdeen of the Department of Scientific and Industrial Research, which has carried out extensive investigations into such matters, has established that at a temperature of 0°C (32°F) the growth rate of bacteria is slow but that it increases rapidly with rise in temperature and at 4.4°C (40°F) fish becomes stale more than twice as quickly as at 0°C, while at 10°C (50°F) bacterial growth is such that fish can grow stale six times faster than at 0°C. Other authorities on the subject have stated that fish can be expected to remain in good condition for 3½ days at 10°C (50°F), for 10½ days at 2°C (36°F) and for 16 days at 0°C (32°F). Canadian

Scientists have concluded that properly iced fish will be as good at the end of 8 days as that which has been kept at a temperature of 2.8°C (37°F) for 5 days or at 5.6°C (42°F) for 3½ days or for 1½ days at 10°C (50°F).

6. According to the above criteria, the samples of uniced Irish fish investigated (paragraphs 2 and 4), which were only one day old were of no better quality on reaching the retailer than fish which had been stored 5 to 6 days in ice. Should there have been any delay in getting this fish to the market beyond the one day taken, there would have been a significant deterioration in quality and in certain circumstances even complete loss.

7. In view of the results of these investigations, it can be seen that it is essential to pack the fish in ice if it is to get to the consumer in the best possible condition, apart from minimising any possibility of loss.

8. Estimates of the quantity of ice to be used for this purpose differ considerably. At the very least, there should be one part by weight of ice to four parts by weight of fish; preferably there should be more ice. Some experts recommend one part by weight of ice to 1½ parts by weight of fish. There are so many factors to consider, chief among which is that of ambient temperature which can vary from hour to hour, that it is difficult to lay down a precise rule. However, if 2 stone of ice is provided for each 5 stone of fish, this should suffice as a general rule.

9. The nature of the problem in Ireland, how it arises and the best way of dealing with it are described hereunder.

General Pattern of Sea Fishing in Ireland:

10. Except at a few of the major fishing ports where absences of two or three days are not uncommon, the fishing boats put to sea early each morning, fish all day and return to port the same evening. Apart from pelagic fish, the catch when hauled aboard is gutted and washed. It is then sorted into boxes and stored in the hold. Usually, even in warm weather, it is only when the boats intend to stay at sea overnight that the fish is iced on board. On arrival in port the catch is as a rule either auctioned immediately or transported to the Dublin or Cork fish market. Generally speaking, ice is used during transport only in warm weather. The fish is sold on the market in the early morning and reaches the retailer or processor by about 9.00 a.m. It is then retailed (or processed) and is normally with the consumer (or processor) within 24 hours of capture.

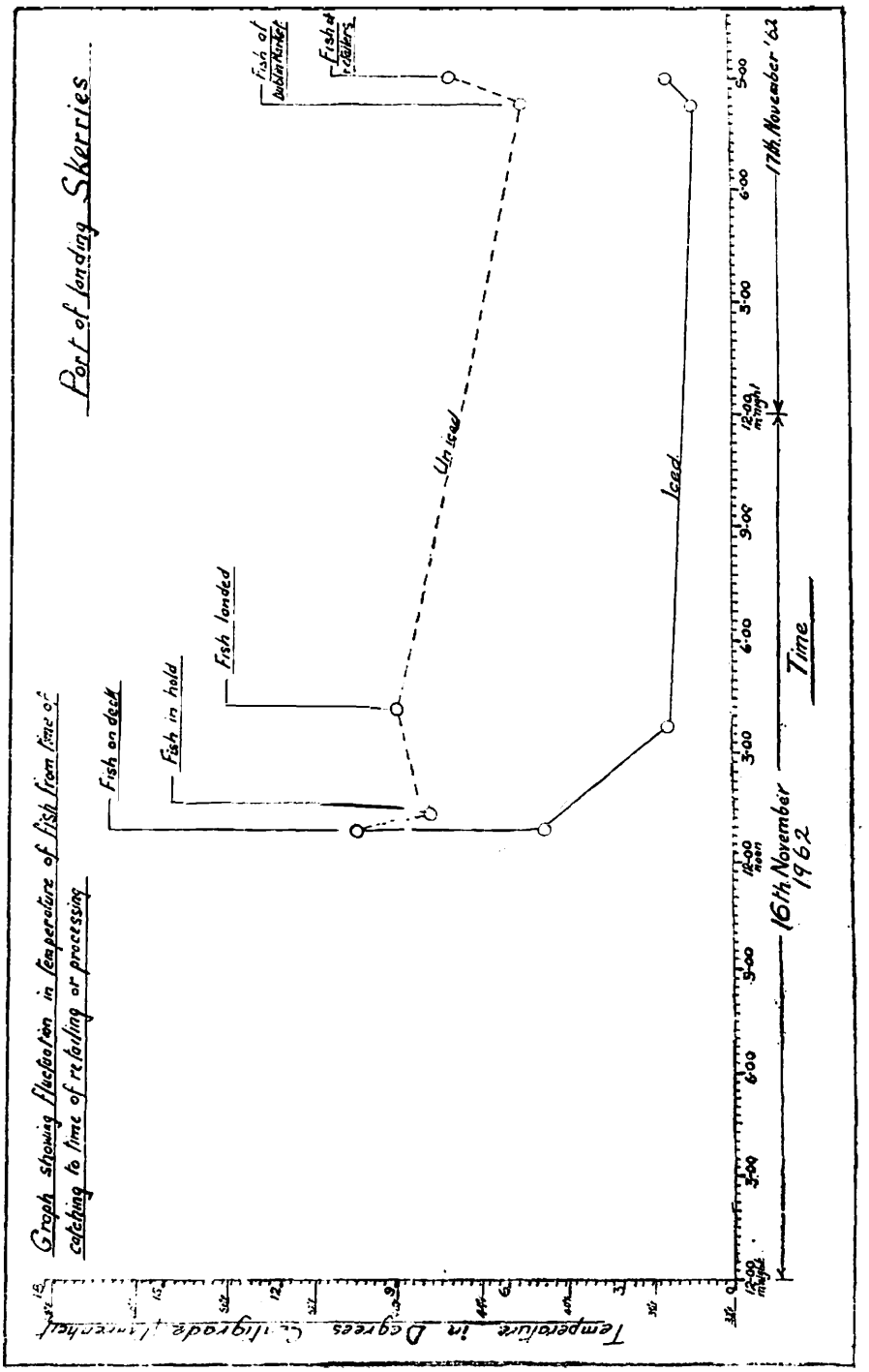
The effect of removal from sea water on the temperature of the fish:

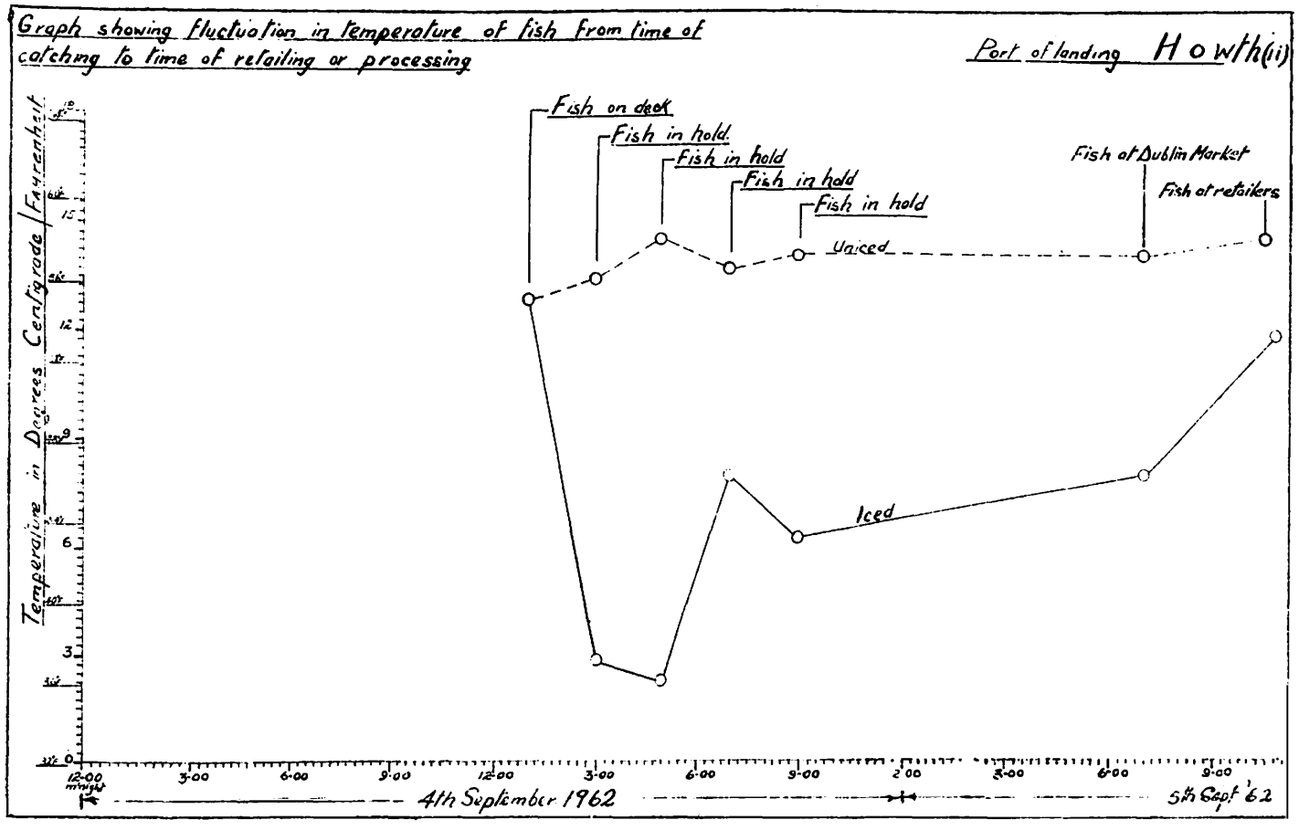
11. It was found that when the fish was removed from the sea its temperature differed from that of the air by a few degrees. In cold weather, the temperature of the fish was usually higher than air temperature; in warm weather, it was lower. After removal from the sea the temperature of the fish altered rapidly until it differed by

only a degree or so from that of the air. As a general rule, the temperature of uniced fish fluctuated with that of the air where there were no other disturbing factors. It was found, however, that, if the fish is properly iced and the ice replenished as necessary, the temperature falls quite quickly almost to freezing point, and remains so until it is sold on the market. If during sale the fish is tipped into another box, thereby disturbing the ice in which it was packed, a rise in temperature results and this practice, therefore, should be avoided as far as practicable.

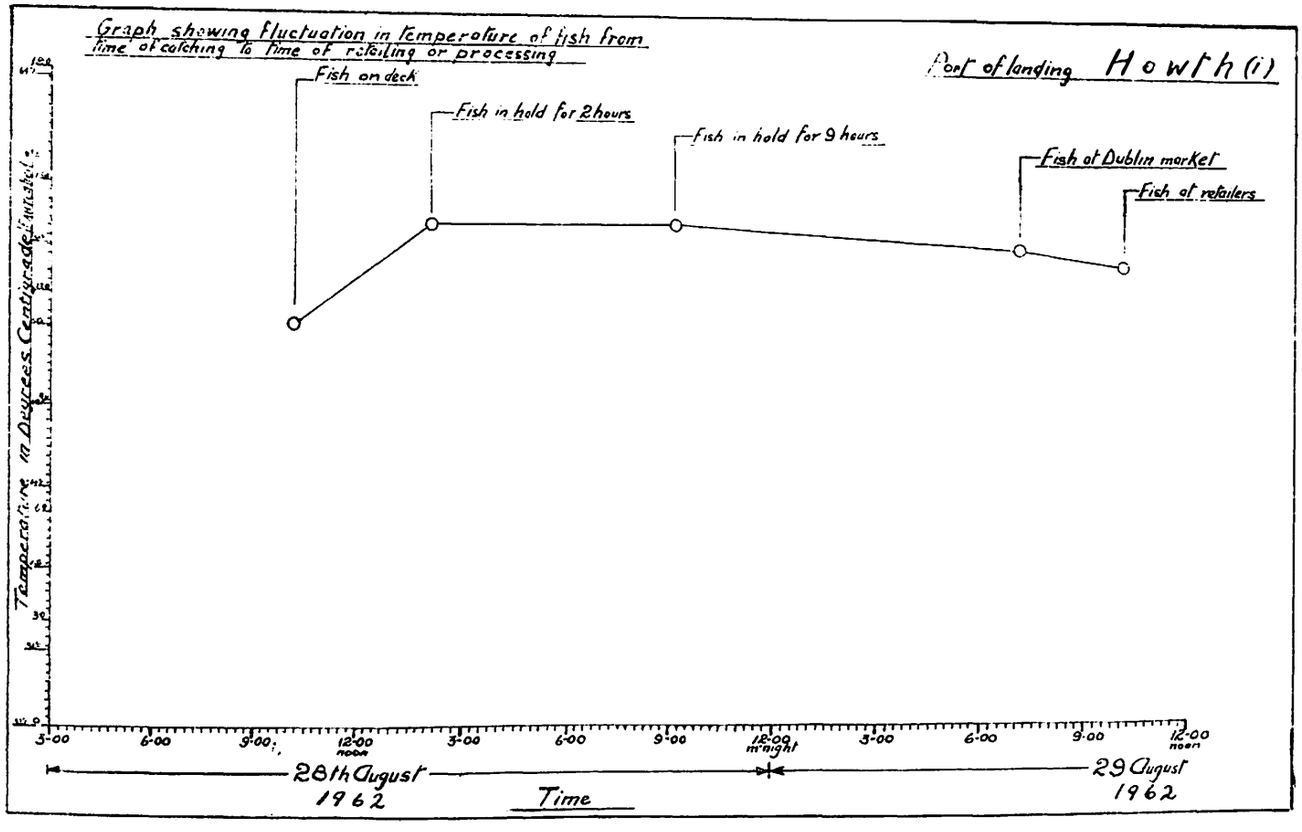
Preventing Spoilage of fish:

12. The principal factor responsible for the deterioration of fish is bacterial activity. Fish spoiling bacteria are not normally present in the flesh of living fish, but shortly after death they enter the flesh through the wall of the gut, the gills, the blood vessels and, eventually, the skin. They multiply rapidly at ordinary air temperature but their activity can be much retarded by lowering the temperature. The most practical way of doing this is to ice the fish as already described. The correct deployment of the ice is of primary importance. Throwing a shovelful of ice on top of the fish in each box serves little purpose. It is essential that the ice should make close contact with each layer of fish. To ensure this, it is necessary to pack the ice in layers below, between and above the fish. It is also worthwhile packing ice into the gut cavity of the larger fish. If at any stage, the ice on top of the box melts, it should be replenished without delay.

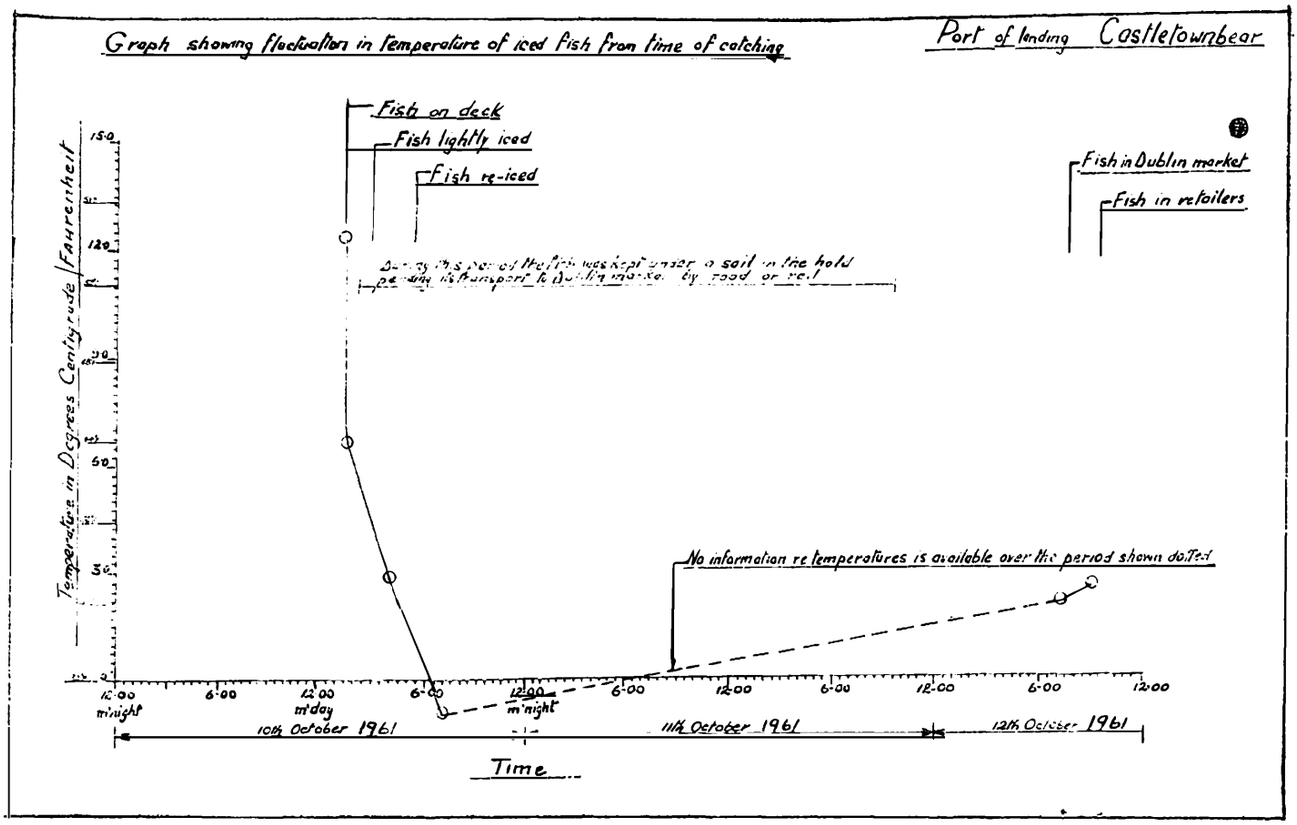

Graph showing fluctuation in temperature of fish from time of catching to time of refueling or processing
Port of landing Skerries
Fish on deck
Fish in hold
Fish landed
Fish of Outlanders
Fish of Outlanders
Un iced
Iced
Temperature in Degrees Centigrade (Centrical)
Time
16th November 1962
17th November '62


Graph showing fluctuation in temperature of fish from time of catching to time of retailing or processing
Port of landing Howth(i)
Temperature in Degrees Centigrade / Fahrenheit
Fish on deck
Fish in hold
Fish in hold
Fish in hold
Fish in hold
Uniced
Fish at Dublin Market
Fish at retailers
Iced
12-00 midnight
3-00
6-00
9-00
12-00
3-00
6-00
9-00
2-00
3-00
6-00
9-00
4th September 1962
5th Sept '62

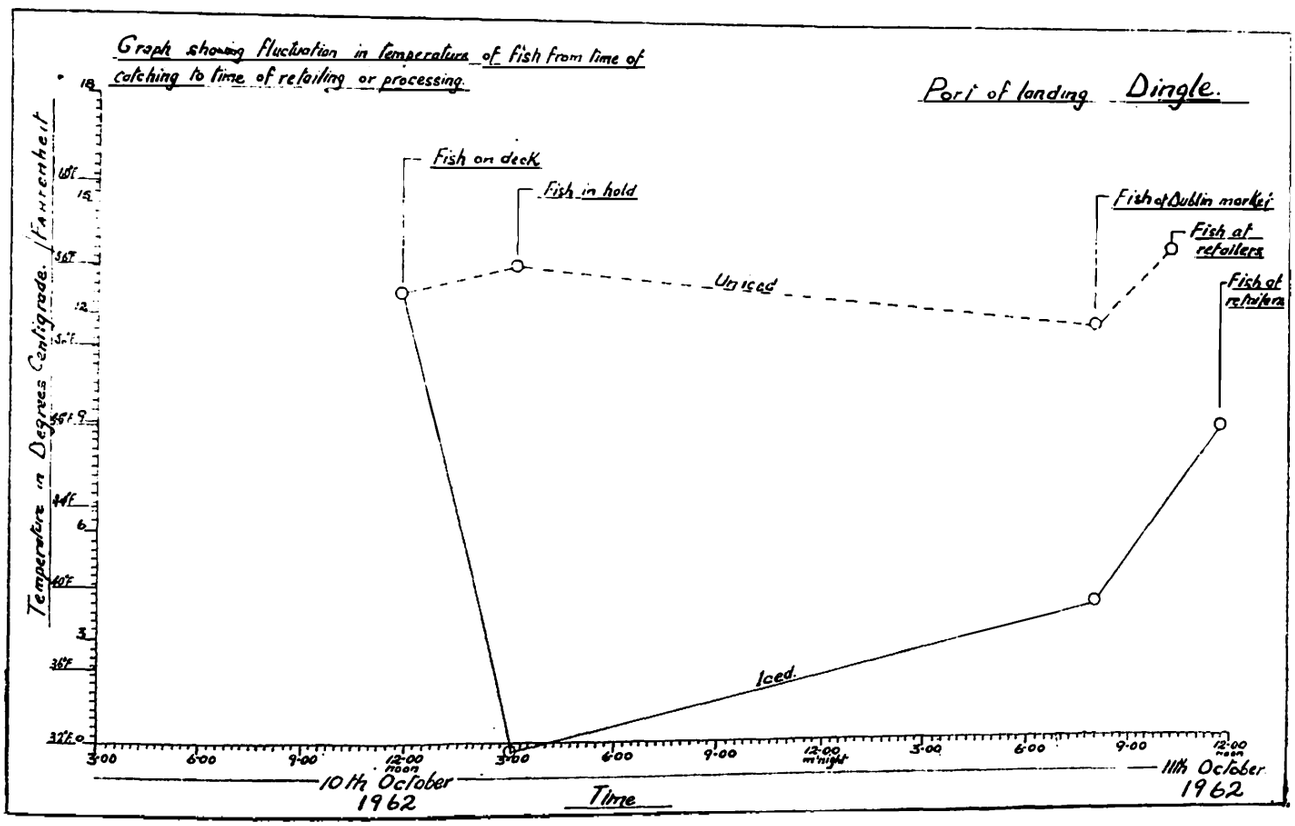
118


Graph showing fluctuation in temperature of fish from time of catching to time of retailing or processing
Port of landing Howth (i)
Temperature in Degrees Centigrade / Fahrenheit
Fish on deck
Fish in hold for 2 hours
Fish in hold for 9 hours
Fish at Dublin market
Fish at retailers
3-00
6-00
9-00
12-00 noon
3-00
6-00
9-00
12-00 midnight
3-00
6-00
9-00
12-00 noon
28th August 1962
29 August 1962
Time

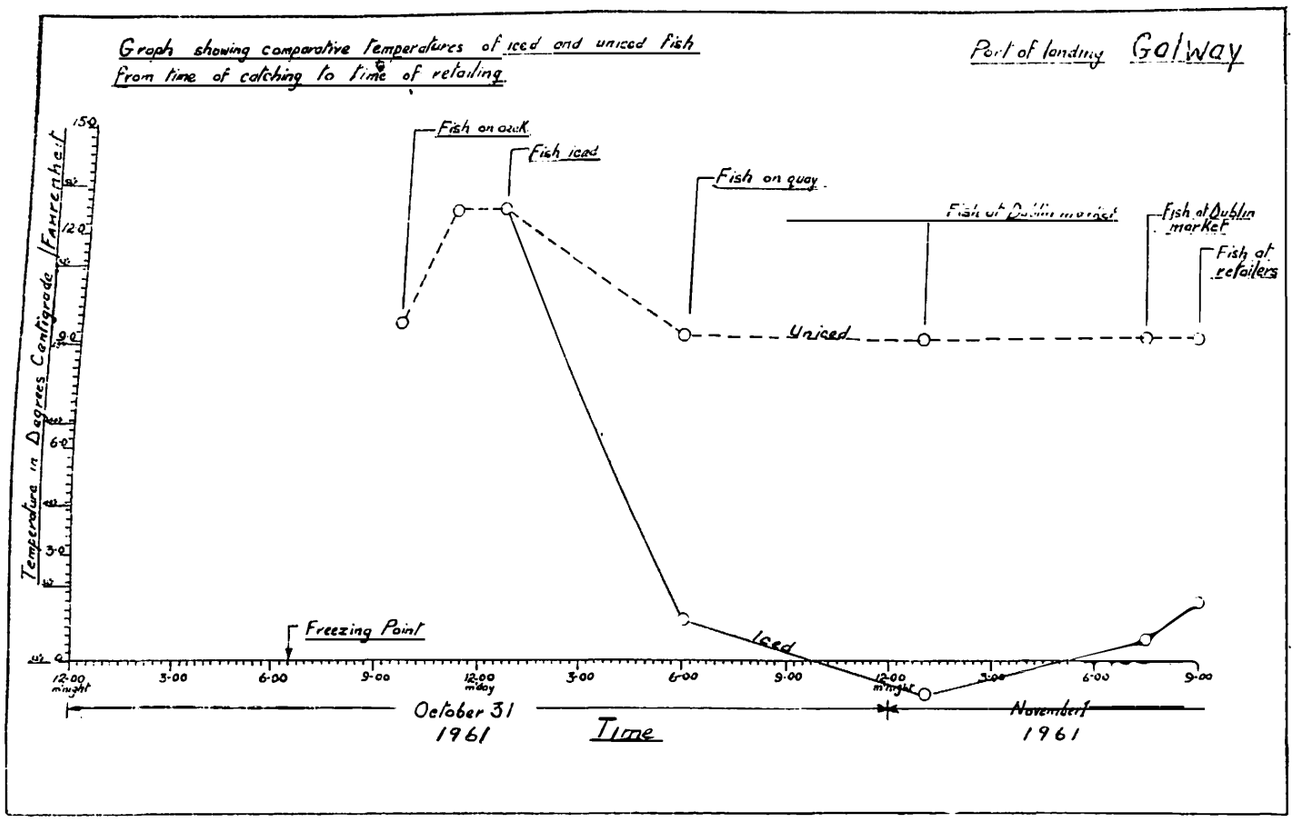
119


Graph showing fluctuation in temperature of iced fish from time of catching
Port of landing Castletownbear
Fish on deck
Fish lightly iced
Fish re-iced
Fish in Dublin market
Fish in retailers
No information re temperatures is available over the period shown dotted
Temperature in Degrees Centigrade / Fahrenheit
12·00 m'night
6·00
12·00 m'day
6·00
12·00 m'night
6·00
12·00
6·00
12·00
6·00
12·00
10th October 1961
11th October 1961
12th October 1961
Time

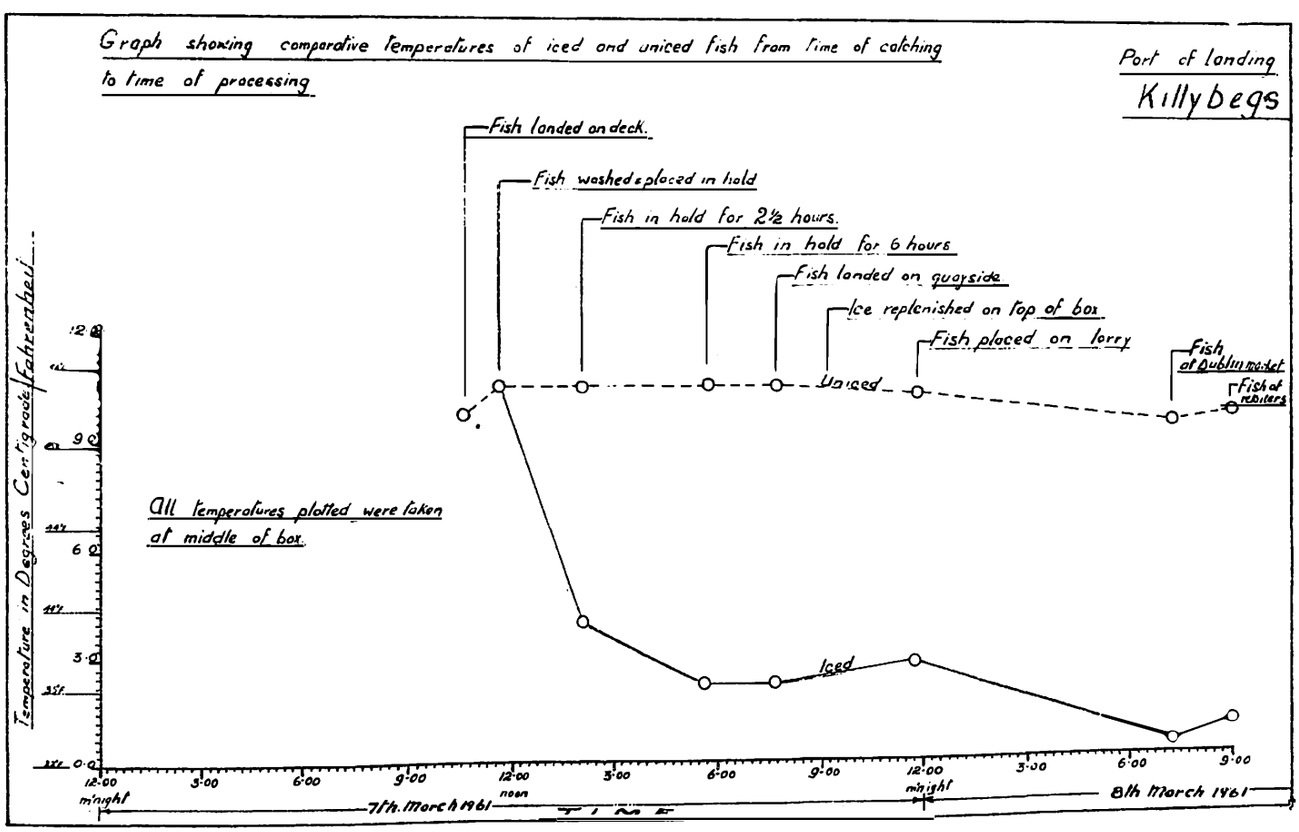
120


Graph showing fluctuation in temperature of fish from time of catching to time of retailing or processing.
Port of landing Dingle.
Fish on deck
Fish in hold
Fish at Dublin market
Fish at retailers
Fish at retailers
Un iced
Iced.
Temperature in Degrees Centigrade. / Fahrenheit
3·00
6·00
9·00
12·00 noon
3·00
6·00
9·00
12·00 m'night
3·00
6·00
9·00
12·00 noon
10th October 1962
11th October 1962
Time

121


Graph showing comparative temperatures of iced and uniced fish from time of catching to time of retailing.
Port of landing Galway
Temperature in Degrees Centigrade/Fahrenheit
Fish on deck
Fish iced
Fish on quay
Fish at Dublin market
Fish at Dublin market
Fish at retailers
Uniced
Iced
Freezing Point
12-00 midnight
3-00
6-00
9-00
12-00 midday
3-00
6-00
9-00
12-00 midnight
3-00
6-00
9-00
October 31 1961
Time
November 1 1961

122


Graph showing comparative temperatures of iced and uniced fish from time of catching to time of processing
Port of landing
Killybegs
Temperature in Degrees Centigrade/Fahrenheit
Fish landed on deck.
Fish washed & placed in hold
Fish in hold for 2½ hours.
Fish in hold for 6 hours
Fish landed on quayside
Ice replenished on top of box
Fish placed on lorry
Fish at Dublin market
Fish at retailers
Uniced
Iced
All temperatures plotted were taken at middle of box.
12-00 midnight
3-00
6-00
9-00
12-00 noon
3-00
6-00
9-00
12-00 midnight
3-00
6-00
9-00
7th March 1961
8th March 1961
TIME

123

APPENDIX No. 32

AN ADVISORY NOTE ON THE PRESERVING OF FISH BY FREEZING AND COLD STORAGE

by

DESMOND MCCARTHY, B.A., B.A.I., Assistant Engineer

The preservation of food by freezing and cold storage has become widely practised in recent years. In this way fish can be stored for quite long periods and still reach the consumer virtually indistinguishable from the fresh article. Certain principles and procedures must, however, be strictly observed, the more important of which are stated under.

1. THE FISH

1. Only fresh fish of prime quality should be processed.

1.2. Freezing cannot improve the quality of the fish. At best, the frozen fish can be only as good as it was before freezing. Freezing should never be looked on as an outlet for fish which is no longer really fresh. It is most important that the public should be confident that when buying frozen fish they are getting fish in first class condition.

1.3. To ensure that fish will be in first class condition when it arrives for processing, it should be iced down when taken on board the catching vessel and held in ice until it is introduced to the processing cycle. A box in which fish is to be packed should have a carpet of ice in the bottom. More ice should then be packed carefully between the layers of fish finishing with a carpet of ice on top before the lid is closed. This ice on top should be replenished from time to time as required.

1.4. The quantity of ice to be used varies according to circumstances. In general, however, about two stones of ice will be required for five stones of fish if the fish is kept overnight before processing.

1.5. If fish is not treated as described above, it deteriorates rapidly at ordinary air temperatures and eventually gives off objectionable odours and becomes inedible. This is known as spoilage for which the main factors responsible are enzymes and bacteria.

1.6. Enzymes are non-living substances which promote chemical changes in living matter. They are present in fish in small amounts. Different enzymes are responsible for different reactions. Some of them facilitate the digestion of proteins into simpler substances thus softening the flesh and altering its appearance ; other enzymes help in the breakdown of oils and

fats while others still encourage the combination of the fats and certain other constituents with oxygen of the air to form substances possessing objectionable odours, flavours and sometimes appearance. The enzymes which promote the chemical changes involved in the spoilage of fish are those contained in the digestive juices. While the fish is alive, the wall of the gut can resist the digestive action promoted by these enzymes, but when the fish dies it is no longer able to do so. The digestive juices then attack the wall of the gut, eat through it and attack the surrounding flesh. This process is more or less rapid at ordinary air temperatures. There are also enzymes in the flesh itself which, after the death of the fish, promote the reaction causing the flesh to soften and disintegrate. Enzymes are destroyed by cooking.

1.7. Bacteria causing fish spoilage are found in sea water and in sea mud. They enter the gut of the fish with food and are found also on the outer surfaces of the fish. They are by far the most important spoilers of fish at ordinary air temperatures. It will be clear, therefore, how necessary it is to wash and gut fish properly immediately, or as soon as practicable, after catching. However, washing and gutting only reduce the number of bacteria—they do not eliminate them.

1.8. The flesh of the living fish does not normally contain fish spoiling bacteria but a short time after death they enter the flesh through the gills and the blood vessels and eventually through the skin. They multiply rapidly at ordinary air temperatures and are responsible for the disagreeable odours which are associated with stale fish. The outer surfaces of the fish from which the invasion starts become covered with dirty slime which harbours bacteria and their secretions, as a result of which the fresh bloom of the fish disappears.

2. FREEZING THE FISH

2.1. After suitable preparation the fish should be quick frozen without loss of time.

2.2. To quick freeze fish it is necessary to reduce the temperature throughout the whole fish from 0°C (32°F) to —5°C (23°F) within a period of 2 hours at most. Thereafter freezing should continue down to the temperature required which depends on the expected duration of cold storage as indicated in the table at 3.8 under.

2.3. A freezer capable of reducing the temperature of fish being processed in this way is essential in every fish freezing centre. The cold store should never be used to freeze the fish as the process is too slow.

2.4. Denaturation of the protein occurs if the temperature is not reduced from 0°C (32°F) to —5°C (23°F) in the time stated. It takes place most rapidly at about —3°C (26.6°F) which is just below the temperature at which fish freezes. If freezing is slow, as would be the case if done in a cold store, denaturation will result in the quality of the fish becoming inferior after a few weeks' storage. White fish so frozen is found, on thawing, to be opaque instead of glossy and translucent, while salmon becomes dull and opaque; the flesh is spongy, instead of firm and elastic, and yields a ragged and unsightly fillet or cut.

2.5. Quick freezing is carried out in equipment specially designed for that purpose, the more common types being contact plate freezers or air blast freezers.

2.6. In contact plate freezers the fish, in blocks or packets, is placed between plates which are refrigerated. They are part of an hydraulic press system by which close contact is maintained between the refrigerating plates and the blocks of fish. The blocks or packets of fish should not exceed 3" in thickness. The time necessary to quick freeze blocks or packets of a thickness greater than 3" exceeds the maximum recommended with a corresponding adverse effect on the quality of the fish as at 2.4 above. Contact plate freezers are the best method of treatment for packets of uniform size. For each batch frozen uniformity of size is essential with such freezers; otherwise, inefficient working of the freezer will result.

2.7. Air blast freezing consists of exposing the fish to a current of cold air. The air is cooled to a temperature of from —29°C (—20°F) to 40°C (—40°F) and is directed over a batch of fish at a high velocity thereby cooling the fish rapidly. By this method assorted sizes of whole fish such as salmon or cod, or packets or irregular shapes can be frozen at the same time. A disadvantage of this method is the loss of weight in the process amounting to 0.5% to 2%.

3. STORING THE FISH

3.1. After quick freezing, the fish should be placed in a cold store the temperature of which is maintained constant according to the figures shown in table at paragraph 3.8 under for varying periods of storage.

3.2. Cold stores are buildings specially designed, built and equipped for the storage of food at low temperatures for operation by people fully qualified and experienced in refrigerating techniques.

3.3. It has been established that —29°C (—20°F) is the most suitable temperature to maintain in a cold store for the long

term storage of quick frozen fish, as it has been found that this temperature retards deteriorative processes to a considerable degree. Lower temperatures will, of course, ensure greater keeping quality of processed fish but the very high cost of providing lower temperatures will hardly be found warranted by the benefits so derived.

3.4. The frozen product should not be placed in direct contact with the floor or with the walls of the store. It should be placed on a rack or platform with a clear space all round to facilitate the circulation of cold air. If this is not done but instead the produce is densely piled, heat develops in the fish muscles due to the influence of enzymatic promoted chemical reaction with consequent deterioration of the product.

3.5. Frozen fish can deteriorate even at —29°C (—20°F) unless precautions are taken to inhibit oxidation and evaporation.

Oxidation is the chemical combination of constituents of fish flesh or fish oil with the oxygen of the air. It is very probably accelerated by the presence of enzymes. It is much more marked in fat fish such as herring and mackerel to which, at low temperatures, it imparts a rusty appearance and a disagreeable odour and flavour. White fish in similar circumstances and probably for the same reason acquires a "malty" or "salt-fishy" odour when stored at too high a temperature.

Evaporation of moisture from the surface of the frozen fish leads to deterioration and causes the whitened toughened wrinkled patches observed on the surface of frozen fish and generally referred to as "freezer burn". The moisture removed from the surface of the fish by the circulating air is deposited on the cooling coils of the refrigerating system.

Protection against oxidation and evaporation is provided by glazing or by efficient wrapping of the product. Glazing consists of covering the frozen product in a film of ice by dipping in or spraying with water. In this way access of air to the surface of the fish is limited. Evaporation still takes place but only from the protective glazing cover. The glazing has to be renewed about every three months. In wrapping, the fish is enclosed in a moisture vapour proof covering e.g. certain kinds of cellulose film, specially processed paper, etc. Care must be taken to ensure that no air pockets are left between the wrapping and the fish as this prevents the proper freezing of the fish.

3.6. Frozen fish loses a certain percentage of weight during cold storage. Thi s amounts to 1.5% of its weight per month at —29°C (—20°F) if not glazed or if unwrapped. When suitably glazed or wrapped the loss in weight may be reduced to 0.25% of its weight per month. These figures are correspondingly higher with increase in temperature of the cold store; at —9°C (15.8°F) the figures can be 7% and 2.5% respectively.

3.7. There should be as few entrances as possible to cold stores and these should be opened as rarely and as shortly as practicable. Where there are two or more doors they should never be open simultaneously. If possible, ante-chamber or "air lock" should be provided.

3.8. Provided all recommended precautions are observed, the safe storage life of frozen fish should be as follows:

Temperature	Storage time	
	Lean Fish	*Fat Fish*
—18°C (0°F)	3 months	2 months
—24°C (—10°F)	6 months	4 months
—29°C (—20°F)	12 months	8 months

3.9. Fish and other food products should not be cold stored together.

4. THE DISTRIBUTION AND STORAGE OF THE FISH BEFORE CONSUMPTION

4.1. Suitably insulated and refrigerated bulk containers should be available for the distribution of the frozen fish from the cold store. It is inevitable that there will be some rise of temperature of the frozen product while in transit, but it should not be allowed to rise above —18°C (0°F).

4.2. In the absence of refrigerated bulk containers, the use of solid carbon dioxide, commonly known as "dry ice", can be recommended as a convenient and comparatively cheap method of maintaining frozen fish at a low temperature during transport. The advantages of "dry ice" are that it has a high refrigerating effect, it is not bulky, it is independent of any source of power and its use requires no skilled supervision. The containers for "dry ice" should be free from air leaks.

4.3. Frozen food cabinets are available for the storage and display of frozen fish for retail sale and the fish should be placed in these immediately on arrival. Care should be taken to ensure that the units are operating at the temperatures recommended by the manufacturers. Stocks of frozen fish should be disposed of in the order of arrival, existing stocks being sold before new stocks because of the limited shelf life of frozen produce in such containers.

4.4. Some shop and most household refrigerators are capable of providing temperatures around 0°C (32°F) only and should not be utilised to store even the most carefully handled fish for more than one or two days.

4.5. The range of temperatures through which the frozen product passes from producer to consumer should be maintained as

constant as possible and fluctuation within the range kept to a minimum. IN NO CIRCUMSTANCES, SHOULD FISH WHICH HAS BEEN THAWED OR PARTIALLY THAWED BE REFROZEN.

5. THAWING THE FISH

5.1. Small to medium sized frozen fish fillets can be cooked without any special arrangements for prior thawing. In fact, this is desirable as it prevents the loss of juices and preserves full flavour. It is necessary, of course, to lengthen the time of cooking to compensate for the low temperature of the fish at the commencement of cooking.

5.2. Large sized units of fish, e.g. whole codling, cod or haddock, should be allowed to thaw before being cooked. This may be done in the household by leaving the fish exposed to room temperature for up to twelve hours depending on the thickness of the fish.

5.3. Large quantities of fish may be thawed by exposure to a current of warm air which, so as to avoid drying out of the fish, should first have been passed through a spray of water. It is important to ensure that the temperature of fish being thawed does not rise above 16°C (61°F) as cooking commences at that temperature. A single round fish of about 2" diameter will thaw in about 6 hours in air at 16°C. The corresponding time for a 3" diameter fish is 10 hours.

5.4. Fish is sometimes thawed by immersion or by placing in running water. This is not recommended because (a) flavouring constituents will be leached out, especially in running water and (b) the fish may absorb too much water and become water logged.

5.5. Dielectric thawing is an excellent method of thawing fish. It is a comparatively recent innovation. It is reported that by this method it is possible to thaw a 12" x 8" x 1¾" block of cod fillets in 20 minutes.

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